Missouri Department of Natural Resources

Biological Assessment Study

Little Tarkio Creek
Holt County

2005 - 2006

Prepared for:

Missouri Department of Natural Resources
Division of Environmental Quality
Water Protection Program
Water Pollution Control Branch

Prepared by:

Missouri Department of Natural Resources
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1.0 Introduction

At the request of the Missouri Department of Natural Resources (**MDNR**), Water Pollution Control Branch (**WPCB**), the Environmental Services Program (**ESP**), Water Quality Monitoring Section (**WQMS**) conducted a macroinvertebrate biological assessment and stream habitat study on Little Tarkio Creek in Holt County, Missouri. The stream is currently on the 2002 303(d) list for impacts from sediment. Four sample stations located within a 17.5-mile segment of Little Tarkio Creek were used to make the assessment. Macroinvertebrate data collected at study stations were compared to biological criteria reference stream data collected from the Plains/Missouri Tributaries between Nishnabotna and Platte Drainages Ecological Drainage Unit (**EDU**).

1.1 Study Area/Justification

Little Tarkio Creek originates in eastern Atchison County between the towns of Tarkio and Burlington Junction. It flows to the south and discharges into the Missouri River near the town of Fortescue in Holt County. The section of Little Tarkio Creek being assessed in this study is listed in the Missouri Water Quality Standards (MDNR 2005a) as a class "P" stream for a distance of 17.5 miles. Designated uses for Little Tarkio Creek are "warm water aquatic life protection, human health/fish consumption, livestock and wildlife watering, category B whole body contact recreation, and secondary contact recreation." Based on our personal observations and topographic map comparison the lower part of Little Tarkio Creek appears channelized and rerouted. Most of the study reach is no longer in its original channel and man-made levees have been constructed on both banks. The Little Tarkio Creek watershed is about 178 square miles with about 79% of the land use in cropland and about 15% in grassland (U.S. EPA 2006). The only point source that discharges into the Little Tarkio Creek watershed is the Craig Wastewater Treatment Facility with a design flow of 0.08 million gallons per day (**MGD**).

1.2 Purpose

The purpose of the study is to determine if the Little Tarkio Creek macroinvertebrate community is impaired. If Little Tarkio Creek is impaired, a second objective is to determine the cause of impairment.

1.3 Objectives

1) Determine if the macroinvertebrate community and water quality in Little Tarkio Creek is impaired compared to data collected from biological criteria reference streams in the Plains/Missouri Tributaries between Nishnabotna and Platte Drainages EDU.

2) Assess the habitat quality of Little Tarkio Creek.

1.4 Tasks

1) Conduct a bioassessment of the macroinvertebrate community on Little Tarkio Creek at four sampling stations during the fall 2005 and spring 2006 sampling seasons.

2) Conduct a water quality characterization at the sampling stations to determine potential water quality impacts.

3) Conduct a stream habitat assessment at the sampling stations to ensure comparability of aquatic habitats.

4) Collect stream width and depth measurements to determine possible habitat alterations caused by past stream channelization.

1.5 Null Hypotheses

1) The macroinvertebrate community will not differ between longitudinally separate reaches of Little Tarkio Creek.

2) The macroinvertebrate community in Little Tarkio Creek will not differ from data collected from biological criteria reference streams in the Plains/Missouri Tributaries between Nishnabotna and Platte Drainages EDU.

3) Stream habitat assessment scores and channel measurements collected will not differ substantially between longitudinally separate reaches of Little Tarkio Creek.

4) Stream habitat assessment scores and channel measurements collected in Little Tarkio Creek will not differ substantially from data collected from biological criteria reference streams in the Plains/Missouri Tributaries between Nishnabotna and Platte Drainages EDU.

2.0 Methods

Carl Wakefield, Mike Irwin, and others from the Missouri Department of Natural Resources, Field Services Division, Environmental Services Program, Water Quality Monitoring Section conducted this study.

2.1 Study Timing

At each sampling station macroinvertebrate and water quality samples were collected once per fall season and once per spring season. The stream habitat assessment and the width and depth measurements were collected during the fall sampling season. Fall sampling was conducted on October 3-4, 2005 and spring sampling was conducted on March 13-14, 2006.

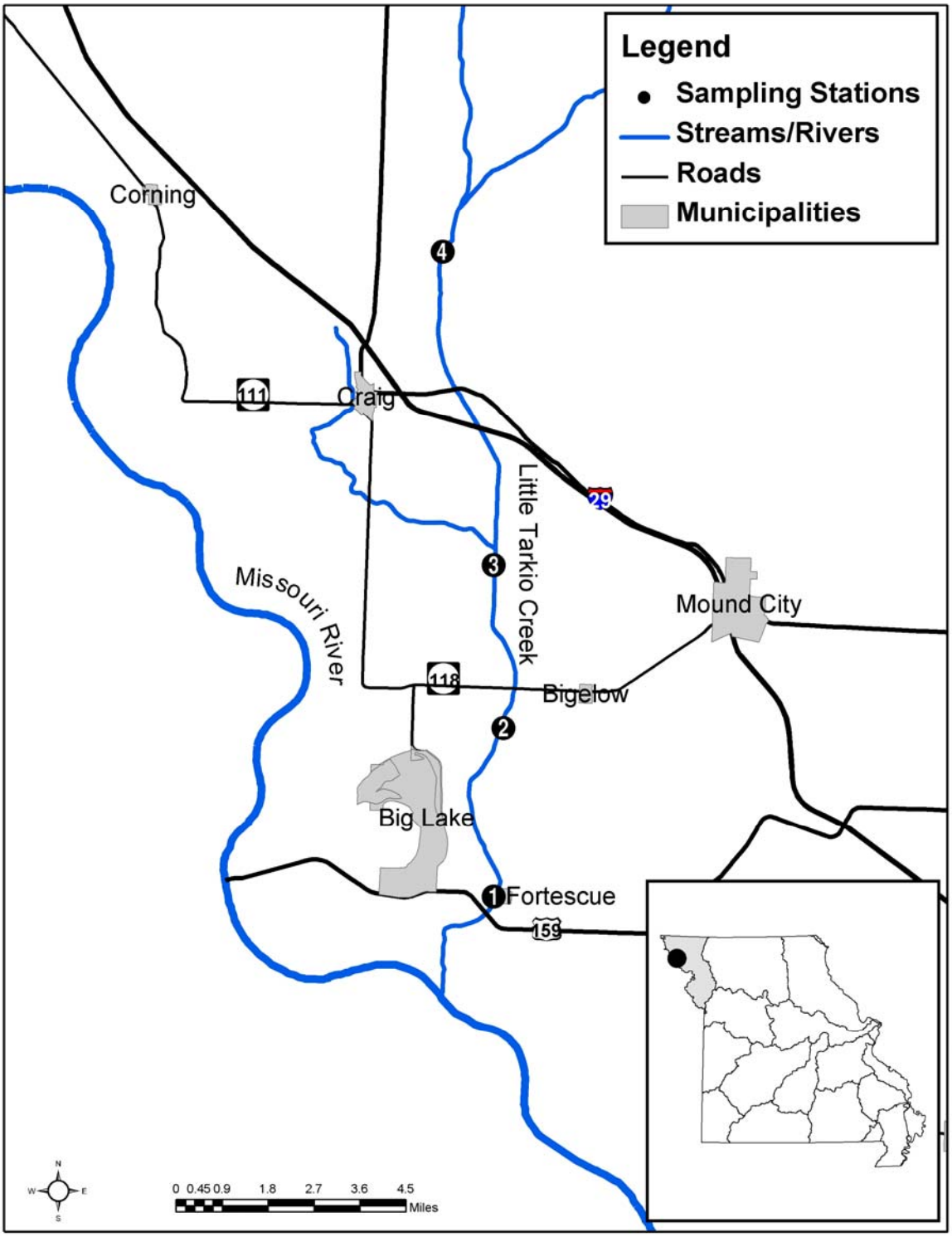
2.2 Station Descriptions

Four test stations were sampled for this study. See Figure 1 for a map of study locations.

Little Tarkio Creek Station #1: Legal description was SE ¼, sec. 32, T. 61 N., R. 39 W. Geographic coordinates were latitude 40.05187 N. and longitude –95.32042 W. Station #1 was located upstream of Highway 159 in Holt County. The station had been channelized into a ditch with tall levees lacking riparian trees on both sides of the stream. Water depth was shallow and woody debris was abundant.

Little Tarkio Creek Station #2: Legal description was NE ¼, sec. 17, T. 61 N., R. 39 W. Geographic coordinates were latitude 40.09973 N. and longitude –95.31942 W. Station #2 was located upstream of County Road 212 in Holt County. The station had been channelized into a ditch with tall levees lacking riparian trees on both sides of the stream. The stream channel was

Figure 1: Map of the Little Tarkio Creek Sampling Stations



very narrow (15-20 feet) and water depth was shallow. There was very little woody debris and rootmat at this station.

Little Tarkio Creek Station #3: Legal description was S ½, sec. 29, T. 62 N., R. 39 W. Geographic coordinates were latitude 40.14655 N. and longitude –95.32422 W. Station #3 was located downstream of County Road 180 in Holt County. The station had been channelized into a ditch with tall levees lacking riparian trees on both sides of the stream. The stream channel was very narrow (15-20 feet) and water depth was shallow. There was very little woody debris and rootmat at this station.

Little Tarkio Creek Station #4: Legal description was SW ¼, sec. 30, T. 63 N., R. 39 W. Geographic coordinates were latitude 40.23440 N. and longitude –95.34732 W. Station #4 was located upstream of County Road 120 in Holt County. There is not as much evidence of channelization at this station compared to other stations. There were no levees on either side of the stream, the riparian zone had some trees, and it was the only station not located in the Missouri River floodplain. The stream channel was narrow and water depth was deep for most of the sampling reach. Woody debris and rootmat were abundant at this station.

2.2.1 Ecological Drainage Unit

An EDU is a region in which aquatic biological communities and habitat conditions can be expected to be similar. A map of the Plains/Missouri Tributaries between Nishnabotna and Platte Drainages EDU is inset in Figure 1. All test stations are within this EDU. Table 1 compares the land cover percentages from the Plains/Missouri Tributaries between Nishnabotna and Platte Drainages EDU and the 14-digit Hydrologic Units (**HU)** containing the Little Tarkio Creek test stations and the biological criteria reference stations in that EDU. Land cover data were derived from Thematic Mapper satellite data from 2000 to 2004 and interpreted by the Missouri Resource Assessment Partnership (**MoRAP**). Cropland was the dominant land use in the Little Tarkio Creek watershed. Forest and grassland was much lower and cropland was much higher in the Little Tarkio Creek watershed compared to values for the entire Plains/Missouri Tributaries between Nishnabotna and Platte Drainages EDU and the biological criteria reference streams (Table 1).

2.3 Habitat Assessment

A standardized assessment procedure was followed as described for Glide/Pool Habitat in the Stream Habitat Assessment Project Procedure (**SHAPP**) (2003a). The habitat assessment was conducted on all stations during the fall 2005 sampling season.

Table 1
Percent Land Cover

Land Cover	14-digit Hydrological Unit (HU)	Urban	Crops	Grassland	Forest	Wetland
EDU	Multiple Hydrological Units	4	53	26	11	0
Little Tarkio Creek #1 and #2	10240005180004	2	**76**	6	1	6
Little Tarkio Creek #3 and #4	10240005180003	2	**80**	9	4	2
Honey Creek	10240012050002	1	36	47	12	1
Long Branch Platte River	10240012080001	1	56	36	7	1
White Cloud Creek	10240013050004	5	65	21	5	1

2.4 Sinuosity

Sinuosity was used as an indicator of historic channelization. Using the National Hydrography Dataset (**NHD**) and Arcmap® software, the sampling stations were placed in the approximate middle of a two-mile stream segment and sinuosity was measured by calculating the ratio of the stream length distance divided by the straight-line distance. Values close to 1.0 are very straight stream reaches, which indicate potential channelization.

2.5 Channel Measurements

The lack of instream habitat can be observed in many northern Missouri streams that are wide and shallow. Wider, shallower streams tend to have less ability to retain pools and woody debris (Haithcoat et al. 2003). At each sampling station, a series of 10 bank-to-bank transects was established. Each transect was equally spaced within the sampling reach, which is 20x the average width. Measurements taken at each transect included lower bank width, wetted width, and water depth at ¼, ½, and ¾ of the distance across the wetted width. To document critical habitat conditions, measurements were collected during the fall low flow period.

2.6 Biological Assessment

Biological assessments consisted of macroinvertebrate collection and physicochemical sampling for the two sample periods.

2.6.1 Macroinvertebrate Collection and Analysis

A standardized macroinvertebrate sample collection and analysis procedure was followed as described in the Semi-quantitative Macroinvertebrate Stream Bioassessment Project Procedure (**SMSBPP**) (2003b). Three standard habitats, depositional substrate in non-flowing water (**NF**), large wood debris (**SG**), and root-mat (**RM**), were sampled at all locations.

Macroinvertebrate data were analyzed using two methods. The first analysis used four general biological metrics found in the SMSBPP. Those metrics are: 1) Taxa Richness (**TR**); 2) Ephemeroptera/Plecoptera/Trichoptera Taxa (**EPTT**); 3) Biotic Index (**BI**); and 4) Shannon Diversity Index (**SDI**). The metric evaluations were determined by comparing Little Tarkio Creek test stations on a seasonal basis to biological criteria calculated from reference stream data collected in the Plains/Missouri Tributaries between Nishnabotna and Platte Drainages EDU. Potential biological impairment of the Little Tarkio Creek test stations was determined by calculating the Missouri Stream Condition Index (**MSCI**), which is the sum of the four biological metric scores. The second analysis of the biological data was an evaluation of macroinvertebrate community percent composition of different macroinvertebrate groups.

2.6.2 Physicochemical Collection and Analysis

Physicochemical samples collected in fall 2005 and spring 2006 were pH, temperature, conductivity, dissolved oxygen, discharge, turbidity, ammonia-N, nitrate/nitrite-N, total nitrogen, chloride, and total phosphorus. Temperature, pH, conductivity, dissolved oxygen, and discharge analyses were conducted in the field. The WQMS measured turbidity in the WQMS Biology Laboratory. All other samples were delivered to the ESP Chemical Analysis Section for analyses. All samples were collected per MDNR-FSS-001: Required/Recommended Containers, Volumes, Preservatives, Holding Times, and Special Sampling Considerations (MDNR 2003e), kept on ice until they were delivered to the ESP laboratory, and recorded on a chain-of-custody per MDNR-ESP-002 (MDNR 2005c).

Results of water quality analyses were compared to Water Quality Standards (MDNR 2005a). The study reach of Little Tarkio Creek is classified as a Class “P” stream and a general warm-water fishery (GWWF). Waters designated as GWWF “allow the maintenance of a wide variety of warm-water biota, including naturally reproducing populations of recreationally important fish species”.

Two other criteria were included to identify limits. The first criterion applied for the “Protection of Aquatic Life”. The second was the rate of exposure, such as chronic or acute exposure. This was important to determine limits for pollutants that could be tolerated by aquatic life over a period of time.

2.6.3 Discharge

Stream flow was measured using a Marsh-McBirney Flow Meter at each station and discharge was calculated as cubic feet per second (cfs). Methodology was in accordance with the standard operating procedure MDNR-WQMS 113: Flow Measurement in Open Channels (MDNR 2003d).

2.7 Quality Control

Quality control was used as stated in the various MDNR Project Procedures and Standard Operating Procedures. A random number of processed macroinvertebrate collections were also rechecked for missed specimens.

3.0 Analyses and Results

Five areas of interest are important to impact assessment in Little Tarkio Creek. These include a physical habitat assessment, stream sinuosity measurements, stream channel measurements, biological assessment, and physicochemical water analyses.

Statistical analyses were performed to find possible differences in watershed size, stream sinuosity, and channel metrics calculated from the channel measurements between sampling stations. The following statistical analyses were performed: One-way analysis of variance (ANOVA) using the Student-Newman-Keuls multiple comparison test, Kruskal-Wallis ANOVA using the Student-Newman-Keuls multiple comparison test, and t-test.

3.1 Habitat Assessment

Table 2 provides habitat assessment scores for Little Tarkio Creek test stations and Honey Creek, a biological criteria reference stream from the Plains/Missouri Tributaries between Nishnabotna and Platte Drainages EDU. Data was collected in the fall 2005 sampling season with Carl Wakefield and Mike Irwin performing the scoring. SHAPP guidance states that a test site scoring at least 75 percent of the total score of a reference station should support a similar biological community. Based on low habitat scores, all Little Tarkio Creek test stations, except station #4, may have problems supporting a reference quality biological community.

Some habitat parameters in the SHAPP, like epifaunal substrate, pool substrate characterization, pool variability, channel alteration, channel sinuosity, and riparian zone condition scored in the poor or marginal category at Little Tarkio Creek test stations #1, #2, and #3 (Table 3). These results indicate that the habitat quality at these stations has been impacted from the channelization of the stream. Most of these habitat parameters, except for epifaunal substrate and channel sinuosity, had higher scores at Little Tarkio Creek #1 compared to test stations #2 and #3.

Table 2
Habitat Assessment Scores for Honey Creek, a Biological Criteria Reference Station, and the Test Stations on Little Tarkio Creek, October 2005

Reference Stream/Station	Habitat Score	Test Streams/Stations	Habitat Score	% of Reference
Honey Creek #1	111	Little Tarkio Creek #1	81	**73**
		Little Tarkio Creek #2	61	**55**
		Little Tarkio Creek #3	61	**55**
		Little Tarkio Creek #4	103	93

Table 3
Predominant Category Habitat Values Estimated from Stream Habitat Assessments for Little Tarkio Creek Test Stations and Biological Criteria Reference Station on Honey Creek

	Little Tarkio Creek #1	**Little Tarkio Creek #2**	**Little Tarkio Creek #3**	**Little Tarkio Creek #4**	**Honey Creek #1**
Stream Habitat Parameters					
Epifaunal Substrate/Available Cover	IV (3.3)	IV (1.1)	IV (2.7)	IV (5.7)	III (18.8)
Pool Substrate Characterization	III	III	III	II	I
Pool Variability	III	IV	IV	II	III
Sediment Deposition	I (5.3)	I (5.9)	I (4.5)	II (49)	I (3)
Channel Flow Status	II	II	II	II	II
Channel Alteration	IV	IV	IV	I	I
Channel Sinuosity	IV	IV	IV	IV	IV
Bank Stability – Left Bank	II	III	IV	III	IV
Bank Stability – Right Bank	III	III	II	III	III
Vegetative Protection – Left Bank	II (90)	II (76)	III (69.5)	II (70)	IV (37.5)
Vegetative Protection – Right Bank	II (85.6)	II (75.5)	II (80.5)	II (76.2)	III (66)
Riparian Zone Width – Left Bank	IV	IV	IV	IV	IV
Riparian Zone Width – Right Bank	IV	IV	IV	II	II

Mean values are listed in parentheses for habitat parameters in which a mean value was calculated. Habitat parameter categories ranged from I to IV with category I = optimal, category II = suboptimal, category III = marginal, and category IV = poor.

3.2 Sinuosity

Sinuosity was close to 1.0 at Little Tarkio Creek test stations #1, #2, and #3 (Table 4). Station #1, located in the middle of a river bend, had a sinuosity value of 1.28. A t-test found that sinuosity at test stations #2, #3, and #4 was not significantly different from the reference stations in the Plains/Missouri Tributaries between Nishnabotna and Platte Drainages EDU ($P = 0.12$) even though the test stations had very low sinuosity values. One possible reason test stations #2, #3, and #4 and the reference stations were not significantly different is that the reference station located on Long Branch Platte River had a low sinuosity value of 1.03.

3.3 Channel Measurements

Table 4 and Figures 2-4 show values for the channel metrics that were calculated from the channel measurements. Figures 2-4 are boxplots of the data and from the top to bottom of each boxplot the horizontal lines represent the 90^{th} percentile, 75^{th} percentile, median, the 25^{th} percentile, and the 10^{th} percentile, with filled circles as outliers.

Little Tarkio Creek test stations had much larger watershed sizes than the reference stations in the Plains/Missouri Tributaries between Nishnabotna and Platte Drainages EDU (t-test, $P = 0.003$), however, the Little Tarkio Creek test stations did not have the physical characteristics of wider channel widths and deeper water depths of a stream with a larger watershed size. The Little Tarkio Creek tests stations generally had narrow channels and shallow water depths (Table 4). The exceptions to this trend were test station #1, which had a wide channel, and test station #4, which had deeper water depths. Channel widths were significantly lower at the Little Tarkio Creek test stations, except test station #1, than the reference stations (One-Way ANOVA, $P < 0.001$; Student-Newman-Keuls Multiple Comparison Test, $P < 0.05$). Little Tarkio Creek test station #1 also had a significantly wider channel width than the other Little Tarkio Creek test stations (Kruskal-Wallis One-Way ANOVA on Ranks, $P < 0.001$; Student-Newman-Keuls Multiple Comparison Test, $P < 0.05$). The Little Tarkio Creek test stations, except test station #1, had smaller wetted widths than the reference stations except for the Long Branch Platte River. Reference station Honey Creek, reference station White Cloud Creek, and Little Tarkio Creek #1 had significantly higher wetted widths than other Little Tarkio Creek test stations (Kruskal-Wallis One-Way ANOVA on Ranks, $P < 0.001$; Student-Newman-Keuls Multiple Comparison Test, $P < 0.05$). The ratio of channel width to wetted width was significantly lower at the Little Tarkio Creek test stations than the reference stations, except for Honey Creek (Kruskal-Wallis One-Way ANOVA on Ranks, $P < 0.001$; Student-Newman-Keuls Multiple Comparison Test, $P < 0.05$). This indicates that water is filling a larger proportion of the channel at the Little Tarkio Creek test stations than at Long Branch Platte River and White Cloud Creek.

Water depth was shallow at the Little Tarkio Creek test stations, except test station #4, and near the water depth values for the reference stations, except for Honey Creek. Little Tarkio Creek test station #4 and the Honey Creek reference station had significantly higher water depths than the other test and reference stations (Kruskal-Wallis One-Way ANOVA on Ranks, $P < 0.001$; Student-Newman-Keuls Multiple Comparison Test, $P < 0.05$). Water depth variation at the sampling stations was analyzed by comparing the standard deviation of the depth. Standard deviation of the depth was higher at Little Tarkio Creek test station #4 than the other test stations and the biocriteria reference stations. A t-test excluding Little Tarkio Creek test station #4 found

that the other test stations had a significantly lower standard deviation of water depth than at the reference stations ($P = 0.004$). Little Tarkio Creek test station #1 had a much higher value and test stations #3 and #4 had much lower values than the reference stations for the ratio of wetted width to water depth (Kruskal-Wallis One-Way ANOVA on Ranks, $P < 0.001$; Student-Newman-Keuls Multiple Comparison Test, $P < 0.05$). Little Tarkio Creek test station #2 also had a much lower value than the reference stations, except Honey Creek, for this ratio. Little Tarkio Creek test station #4 had a much higher maximum depth and test stations #1 and #2 had a much lower maximum depth than at the reference stations, however, a t-test found no significant difference ($P = 0.06$) between the Little Tarkio Creek test stations and reference even when test station #4 was not included in the analysis. These results of water depth indicate that the Little Tarkio Creek test stations, except test station #4, had narrow channel widths, shallow water depths, and a low standard deviation of water depths. Little Tarkio Creek #4 had a narrow channel but had much deeper water depths and higher standard deviation of the water depths. The reference stations, except for Honey Creek, generally had wider stream channels and shallow water depths.

Table 4
Stream Channel Measurements Calculated for the Little Tarkio Creek Test Stations and Biological Criteria Reference Stations Located in the Plains/Missouri Tributaries between Nishnabotna and Platte Drainages EDU

Measurement	**Drainage Area (Miles^2)**	**Sinuosity**	**Channel Width (Feet)**	**Wetted Width (Feet)**	**Ratio of Channel Width to Wetted Width**	**Water Depth (Feet)**	**Ratio of Wetted Width to Water Depth**	**Maximum Depth (Feet)**
Test Stations								
Little Tarkio Creek #1	168	1.28	37.8 ± 4.9	29.0 ± 4.6	1.3 ± 0.2	0.7 ± 0.3	45.9 ± 15.5	1.1
Little Tarkio Creek #2	160	1.02	22.9 ± 2.3	19.4 ± 1.6	1.2 ± 0.0	0.9 ± 0.1	21.1 ± 4.6	1.3
Little Tarkio Creek #3	153	1.00	16.7 ± 1.8	13.2 ± 1.9	1.3 ± 0.1	1.3 ± 0.3	10.3 ± 2.6	1.9
Little Tarkio Creek #4	128	1.04	21.1 ± 3.3	16.8 ± 3.3	1.3 ± 0.3	2.6 ± 0.9	6.7 ± 2.1	4.0
Mean Value	152.3 ± 17.3	1.09 ± 0.13	24.6 ± 8.6	19.6 ± 6.6	1.3 ± 0.2	1.4 ± 0.9	21.0 ± 17.4	2.1 ± 1.3
Reference Stations								
Honey Creek #1	86	1.46	35.4 ± 3.8	31.6 ± 6.6	1.2 ± 0.6	1.6 ± 0.7	21.1 ± 6.0	3.1
Long Br. Platte River #1	22	1.03	31.0 ± 5.4	13.8 ± 6.0	2.7 ± 1.5	0.6 ± 0.5	36.7 ± 18.5	2.1
White Cloud Creek #1	37	1.34	55.7 ± 12.9	27.3 ± 13.5	3.0 ± 2.7	0.9 ± 0.6	31.5 ± 15.5	2.2
Mean Value	48.3 ± 33.5	1.28 ± 0.22	40.7 ± 13.6	24.3 ± 11.8	2.3 ± 1.9	1.0 ± 0.7	29.8 ± 16.5	2.4 ± 0.5

Values are listed in the table as the mean ± SD for the measurements that were collected at multiple transects located within the sampling stations.

Figure 2
Box plots of a) channel widths and b) wetted widths at the biological criteria reference stations Honey Creek (HC), Long Branch Platte River (LBPR), White Cloud Creek (WCC), and the test stations on Little Tarkio Creek (LTC).
Fall 2005

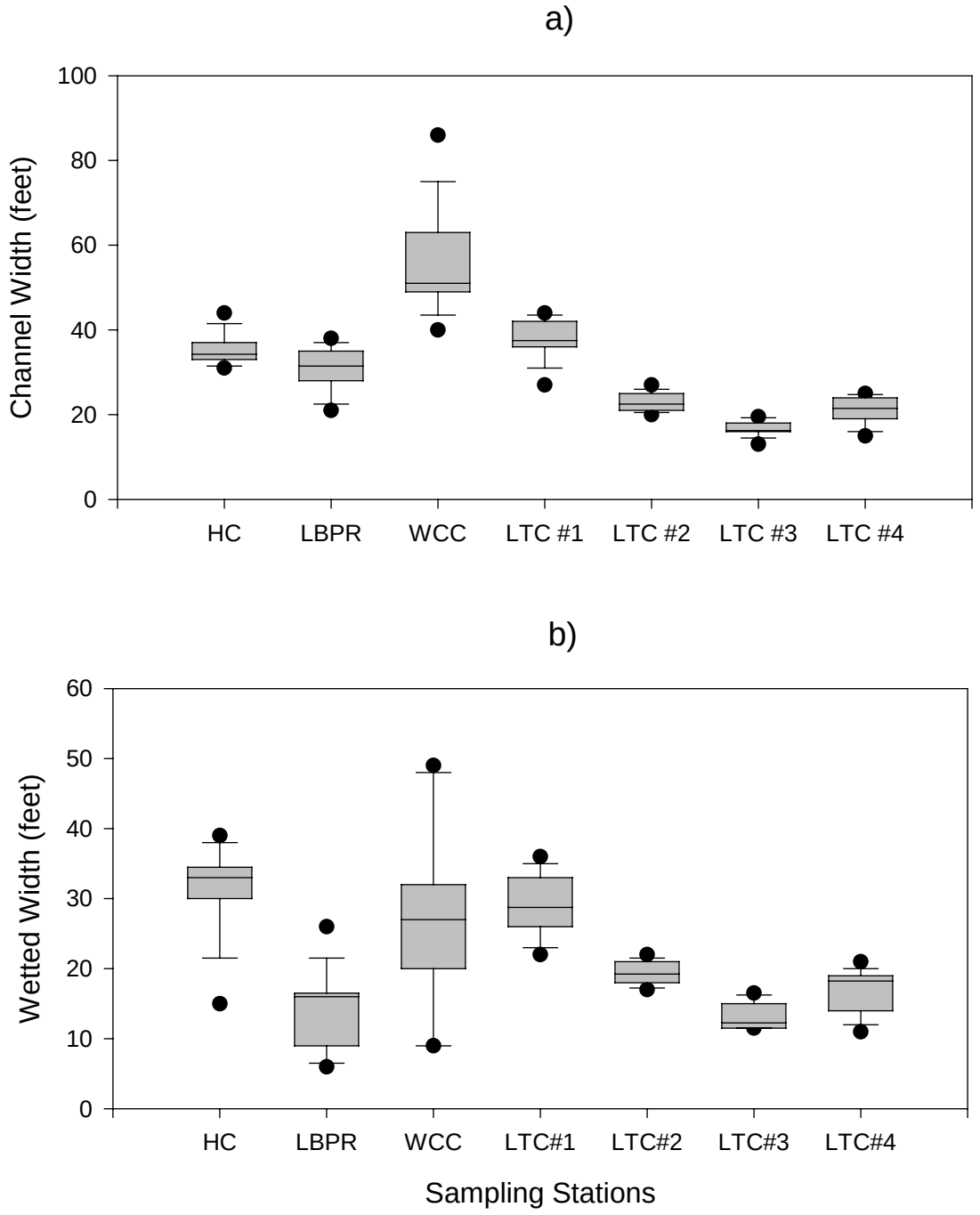


Figure 3
Box plots of a) channel width to wetted width ratio and b) water depths at the biological criteria reference stations Honey Creek (HC), Long Branch Platte River (LBPR), White Cloud Creek (WCC), and the test stations on Little Tarkio Creek (LTC).
Fall 2005

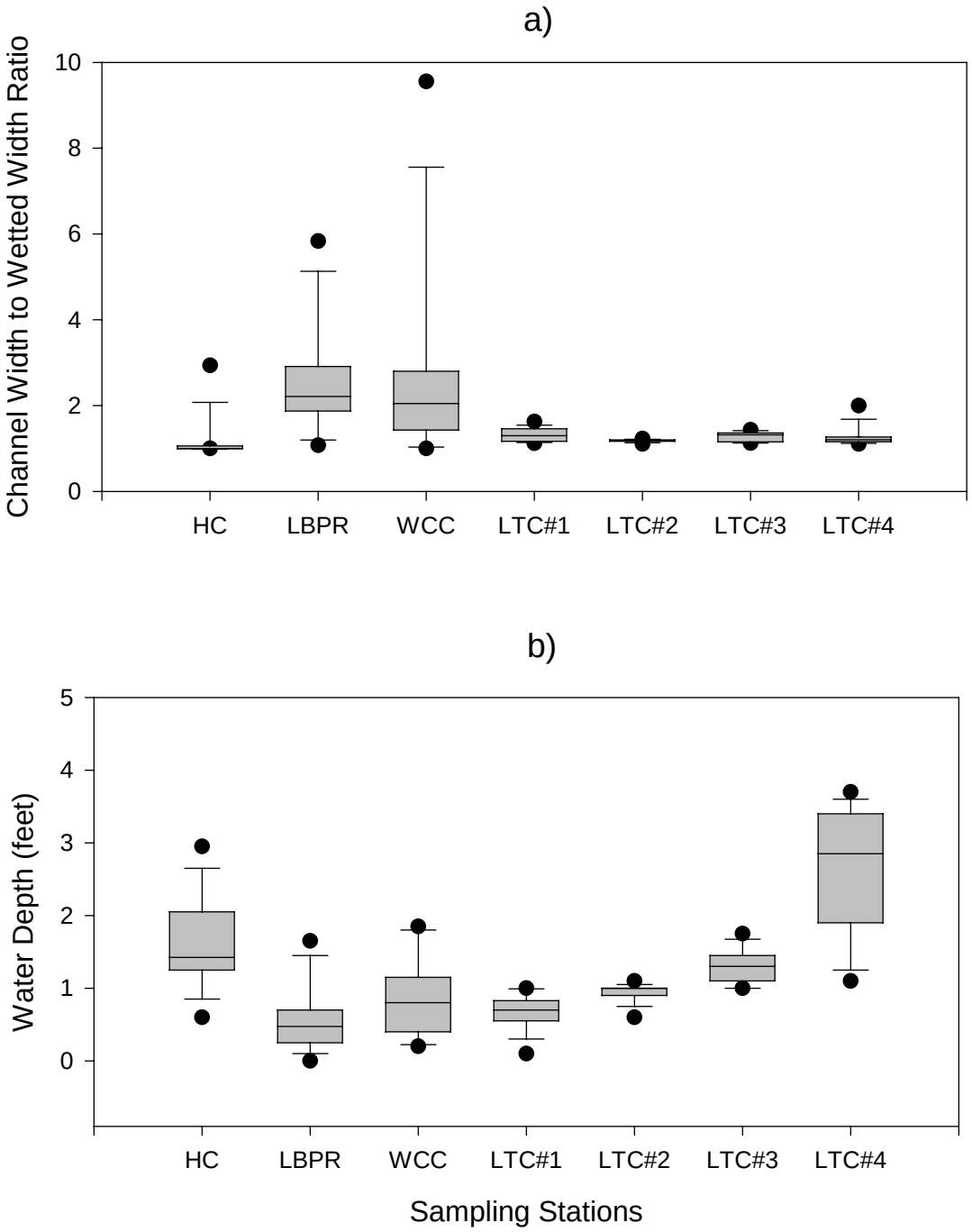
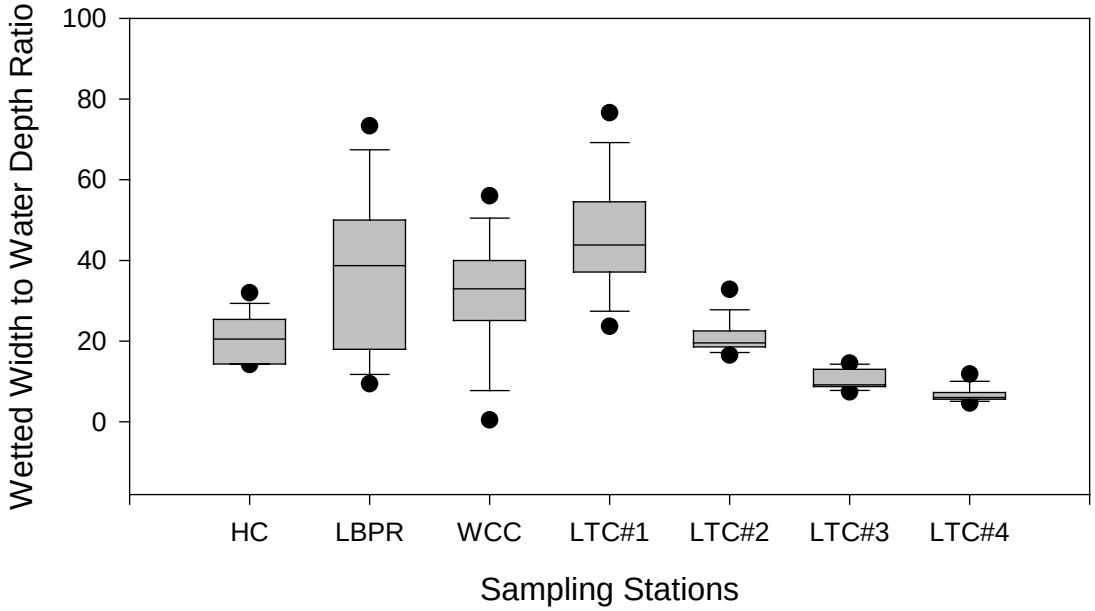


Figure 4
Box plots of wetted width to water depth ratio at the biological criteria reference stations Honey Creek (HC), Long Branch Platte River (LBPR), White Cloud Creek (WCC), and the test stations on Little Tarkio Creek (LTC).
Fall 2005



3.4 Biological Assessment

Macroinvertebrate data were evaluated by two methods. The first analysis used the general biological metrics in the SMSBPP. The second analysis of the biological data was an evaluation of macroinvertebrate community using percent composition of predominant macroinvertebrate taxa.

3.4.1 Semi-quantitative Macroinvertebrate Stream Bioassessment Project Procedure (SMSBPP)

The SMSBPP metric evaluation used numeric biological criteria within the Plains/Missouri Tributaries between Nishnabotna and Platte Drainages EDU that were calculated from the ESP Biological Criteria for Wadeable and Perennial Streams database. Criteria are listed for the fall and spring seasons in Table 5.

Table 5
Biological Criteria Scores Calculated from Biological Criteria Streams in the Plains/Missouri Tributaries between Nishnabotna and Platte Drainages EDU

	Score = 5	Score = 3	Score = 1
Fall Season			
TR	>57	57-28	27-0
EPTT	>9	9-4	3-0
BI	<7.26	7.26-8.63	8.64-10
SDI	>3.02	3.02-1.51	1.50-0
Spring Season			
TR	>44	44-22	21-0
EPTT	>7	7-4	3-0
BI	<7.71	7.71-8.85	8.86-10
SDI	>2.17	2.17-1.08	1.07-0

The metric values and scores for Little Tarkio Creek are presented in Table 6. Little Tarkio Creek had MSCI scores in the full sustainability category at all of the stations for both sampling seasons. During the fall 2005 sampling season all of the stations, except station #3, scored a perfect MSCI score of 20. The scores, on average, during the spring 2006 sampling season were not as high as the scores in the fall 2005 season, with one station scoring 16, two stations scoring 18, and one station scoring 20. Taxa richness, EPTT, and SDI had lower values during the spring sampling season compared to the values in the fall sampling season.

3.4.2 Macroinvertebrate Percent and Community Composition

The macroinvertebrate community composition and biological metric values for samples collected during the fall 2005 and spring 2006 sampling seasons at the Little Tarkio Creek test stations are presented in Tables 7 and 8.

Chironomidae and the netspinning caddisfly family Hydropsychidae were the two most abundant macroinvertebrate families in the fall 2005 sampling season at the Little Tarkio Creek test stations (Table 7). The most abundant chironomid in the Little Tarkio Creek samples was the predatory chironomid *Thienemannimyia* group. Other chironomide taxa that were common in some or all of the samples were *Tanytarsus*, *Chironomus*, *Cryptotendipes*, and *Stenochironomus*. The caddisfly taxa *Hydropsyche* made up most of the caddisflies that were collected from the family Hydropsychidae, except station #3. Station #3 had a much higher abundance of Hydropsychid caddisflies, including a high abundance of the taxa *Cheumatopsyche*. Other EPTT taxa that were fairly abundant were the Leptocerid caddisfly *Nectopsyche* and mayfly taxa in the families Baetidae, Leptohyphidae, and Heptageniidae. The percent ephemeroptera making up each sample ranged from 11.9 at station #3 to 27.3 at station #4. *Tricorythodes* and *Stenacron* made up most of the abundance of mayflies at station #4.

Table 6
Little Tarkio Creek Metric Values and Scores, Using Biological Criteria Calculated from Biological Criteria Reference Streams in the Plains/Missouri Tributaries between Nishnabotna and Platte Drainages EDU

Fall 2005

Sample No./Station	TR	EPTT	BI	SDI	MSCI Score	Sustain.
05-03101						
Little Tarkio Creek #1 Value	70	14	6.24	3.21		
Little Tarkio Creek #1 Score	5	5	5	5	20	Full
05-03102						
Little Tarkio Creek #2 Value	70	15	6.00	3.32		
Little Tarkio Creek #2 Score	5	5	5	5	20	Full
05-03103						
Little Tarkio Creek #3 Value	55	10	5.61	2.71		
Little Tarkio Creek #3 Score	3	5	5	3	16	Full
0503104						
Little Tarkio Creek #4 Value	77	16	5.88	3.19		
Little Tarkio Creek #4 Score	5	5	5	5	20	Full

Spring 2006

06-02615						
Little Tarkio Creek #1 Value	49	6	6.41	1.90		
Little Tarkio Creek #1 Score	5	3	5	3	16	Full
06-02616						
Little Tarkio Creek #2 Value	48	7	6.60	2.89		
Little Tarkio Creek #2 Score	5	3	5	5	18	Full
06-02617						
Little Tarkio Creek #3 Value	55	10	6.39	2.70		
Little Tarkio Creek #3 Score	5	5	5	5	20	Full
06-02618						
Little Tarkio Creek #4 Value	59	7	6.33	2.87		
Little Tarkio Creek #4 Score	5	3	5	5	18	Full

Chironomidae, the most abundant macroinvertebrate family in the Little Tarkio Creek samples collected during the spring 2006 sampling season, ranged from 68.7 percent at station #3 to 93.9 percent at station #1 (Table 8). Chironomid taxa that were abundant in some or all of the samples were *Cricotopus/Orthocladius, Cricotopus bicinctus, Tanytarsus, Polypedilum convictum* group, *Parakiefferiella,* and *Stenochironomus. Cricotopus/Orthocladius* was much more abundant at station #1 and the tolerant *Cricotopus bicinctus* was more abundant at stations #2 and #3. Two chironomid taxa, *Parakiefferiella* and *Stenochironomus,* were much more abundant at station #4. Percent EPT was much lower in the samples during the spring 2006 compared to the fall 2005 samples. Station #3 was the only location where EPT made up a large proportion of the

sample. Most of the abundance at this station was made up by the netspinning caddisfly *Hydropsyche*, which was also very abundant at this station during the fall 2005 sampling period.

Table 7
Macroinvertebrate Community Composition for Little Tarkio Creek Test Stations during the Fall 2005 Sampling Season

Variable-Station	**Little Tarkio Creek #1**	**Little Tarkio Creek #2**	**Little Tarkio Creek #3**	**Little Tarkio Creek #4**
Sample Date	10/04/2005	10/04/2005	10/04/2005	10/03/2005
Macro Sample Number	05-03101	05-03102	05-03103	05-03104
% EPT	32.3	33.5	59.1	47.4
% Ephemeroptera	13.8	13.3	11.9	27.3
% Plecoptera	0	0	0	0
% Trichoptera	18.5	20.2	47.2	20.1
% Dominant Macroinvertebrate Families				
Chironomidae	**35.1**	**50.7**	**26.2**	**32.2**
Corixidae	**16.5**	1.4	0	1.4
Hydropsychidae	**14.8**	**14.5**	**42.6**	**17.5**
Baetidae	**6.5**	**6.3**	3.1	3.3
Tubificidae	**4.2**	2.9	3.9	1.4
Leptoceridae	3.6	**5.7**	4.6	2.6
Elmidae	1.3	**3.8**	**5.0**	**8.0**
Leptohyphidae	2.9	2.8	**6.3**	**13.7**
Heptageniidae	3.8	3.5	**2.2**	**7.7**
% Dominant Macroinvertebrate Taxa				
Trichocorixa	**16.5**	1.4	0	1.4
Hydropsyche	**14.5**	**13.3**	**26.5**	**15.3**
Thienemannimyia Group	**5.8**	**10.9**	**12.0**	**11.8**
Chironomus	**5.4**	0.8	0.2	2.7
Tanytarsus	**4.8**	**10.5**	2.5	1.1
Tubificidae	**3.9**	2.9	3.7	1.4
Nectopsyche	3.6	**5.7**	**4.6**	2.5
Cryptotendipes	0.5	**5.4**	1.6	0.1
Cheumatopsyche	0.3	1.2	**16.1**	2.3
Tricorythodes	3.0	2.9	**6.3**	**13.8**
Stenochironomus	1.1	2.0	0.8	**7.7**
Stenacron	0.7	0.1	0.4	**4.3**

Values in bold indicate the five most abundant macroinvertebrate families and taxa for each sample.

Table 8
Macroinvertebrate Community Composition for Little Tarkio Creek Test Stations during the Spring 2006 Sampling Season

Variable-Station	**Little Tarkio Creek #1**	**Little Tarkio Creek #2**	**Little Tarkio Creek #3**	**Little Tarkio Creek #4**
Sample Date	03/14/2006	03/14/2006	03/13/2006	03/13/2006
Macro Sample Number	06-02615	06-02616	06-02617	06-02618
% EPT	2.3	9.7	18.9	7.6
% Ephemeroptera	0.7	1.1	2.0	2.0
% Plecoptera	0	0.2	0	0
% Trichoptera	1.6	8.4	16.9	5.5
% Dominant Macroinvertebrate Families				
Chironomidae	**93.9**	**82.8**	**68.7**	**71.0**
Simuliidae	**1.8**	**1.4**	**3.0**	0.5
Hydropsychidae	**0.9**	**7.1**	**16.1**	**2.6**
Leptoceridae	**0.7**	1.2	0.8	**2.8**
Tubificidae	**0.7**	0.9	**2.8**	**2.6**
Elmidae	0.1	**1.7**	**3.2**	**5.7**
Ceratopogonidae	0.4	**1.4**	1.4	1.5
Corixidae	0.1	0.1	0.2	**5.0**
% Dominant Macroinvertebrate Taxa				
Cricotopus/Orthocladius	**45.5**	**15.4**	**16.8**	**13.3**
Tanytarsus	**26.7**	**12.4**	0.7	0.7
Polypedilum convictum group	**3.2**	4.4	3.2	0.2
Parakiefferiella	**3.2**	**6.5**	**8.3**	**26.9**
Thienemannimyia group	**3.1**	**7.6**	**9.5**	**9.4**
Cricotopus bicinctus	0.9	**13.8**	**19.7**	3.2
Hydropsyche	0.9	5.7	**14.5**	2.5
Stenochironomus	0.2	0	0.5	**5.2**
Trichocorixa	0.1	0.2	0.2	**5.0**

Values in bold indicate the five most abundant macroinvertebrate families and taxa for each sample.

3.4.3 Physicochemical Water

Physicochemical results are arranged to demonstrate trends of certain variables that may identify a source for impacts to Little Tarkio Creek. Results can be found in Table 9 for fall 2005 and Table 10 for spring 2006 samples. Results specifically discussed in this section are discharge, turbidity, nitrogen, and total phosphorous.

3.4.3.1 Discharge

Discharge during the fall 2005 sampling season ranged from 17.7 cfs at test station #1 to 19.4 cfs at test station #4. Discharge during the spring 2006 sampling season ranged from 14.4 cfs at test station #4 to 16.6 cfs at test station #3.

3.4.3.2 Turbidity

Turbidity was elevated during the fall 2005 sampling season, but was not elevated during the spring 2006 sampling season. Turbidity during the fall 2005 sampling season ranged from 75.0 NTU at test station #1 to 194 NTU at test station #3. During the spring 2006 sampling season, turbidity ranged from 15.0 NTU at test station #1 to 26.2 NTU at test station #4.

3.4.3.3 Nitrogen

Total nitrogen and nitrate + nitrite-N was elevated at the Little Tarkio Creek test stations during both sampling seasons. Total nitrogen ranged from 3.58 mg/L at test station #1 to 3.97 mg/L at test station #4. Nitrate + nitrite-N ranged from 2.92 mg/L at test station #1 to 3.06 mg/L at test station #3. During the spring 2006 sampling season, total nitrogen ranged from 2.11 mg/L at test station #1 to 2.54 mg/L at test station #4. Nitrate + nitrite-N during the spring 2006 sampling season ranged from 1.71 mg/L at test station #1 to 1.99 mg/L at test station #4.

3.4.3.4 Total Phosphorous

Total phosphorous was highest at test station #1 during the fall 2005 sampling season. Total phosphorous during the fall 2005 sampling season ranged from 0.28 mg/L at test station #2 to 3.72 mg/L at test station #1. During the spring 2006 sampling season, total phosphorous ranged from 0.08 mg/L at test station #1 to 0.15 mg/L at test station #3.

Table 9
Physicochemical Variables for the Little Tarkio Creek Study in Fall 2005

Variable-Station	Little Tarkio Creek #1, Test Fall 2005	Little Tarkio Creek #2, Test Fall 2005	Little Tarkio Creek #3, Test Fall 2005	Little Tarkio Creek #4, Test Fall 2005
Physicochemical Sample Number	05-05697	05-05698	05-05699	05-05700
Sample Date	10/04/2005	10/04/2005	10/04/2005	10/03/2005
Sample Time	1725	1305	1020	1545
pH (Units)	8.38	8.24	8.08	7.90
Temperature (C^0)	27.1	25.9	22.1	22.6
Conductivity (uS)	406	394	387	366
Dissolved O_2	8.08	8.34	7.59	7.78
Discharge (cfs)	17.7	18.4	17.8	19.4
Turbidity (NTUs)	**75.0**	**132**	**194**	**171**
Ammonia-N	0.03	0.03	0.03	0.03
Nitrate/Nitrite-N	**2.92**	**2.99**	**3.06**	**3.05**
Total Nitrogen	**3.58**	**3.84**	**3.71**	**3.97**
Chloride	15.7	16.0	15.5	14.6
Total Phosphorus	**3.72**	0.28	0.37	0.31

Units mg/L unless otherwise noted. Values in bold are possibly elevated compared to normal conditions.

Table 10
Physicochemical Variables for the Little Tarkio Creek Study in Spring 2006

Variable-Station	Little Tarkio Creek #1, Test Fall 2005	Little Tarkio Creek #2, Test Fall 2005	Little Tarkio Creek #3, Test Fall 2005	Little Tarkio Creek #4, Test Fall 2005
Physicochemical Sample Number	06-03164	06-03165	06-03166	06-03167
Sample Date	03/14/2006	03/14/2006	03/13/2006	03/13/2006
Sample Time	1100	1300	1555	1355
pH (Units)	8.13	8.14	8.06	7.87
Temperature (C^0)	4.90	9.90	9.00	8.00
Conductivity (uS)	431	408	403	398
Dissolved O_2	13.90	13.50	15.00	14.70
Discharge (cfs)	15.6	15.5	16.6	14.1
Turbidity (NTUs)	15.0	26.0	21.8	26.2
Ammonia-N	0.03	0.03	0.03	0.03
Nitrate/Nitrite-N	**1.71**	**1.73**	**1.88**	**1.99**
Total Nitrogen	**2.11**	**2.35**	**2.36**	**2.54**
Chloride	13.9	14.5	13.1	13.6
Total Phosphorus	0.08	0.12	0.15	0.11

Units mg/L unless otherwise noted. Values in bold are possibly elevated compared to normal conditions.

4.0 Discussion

4.1 Land Use and Its Possible Effect on Water Quality

Row crops made up 76 to 80 percent of the land use in the 14-digit Hydrologic Units (**HU**) that contained the Little Tarkio Creek test stations and were substantially higher than the values for the entire EDU and biological criteria reference stations. This could indicate a source of human stress on the stream since a high percentage of row crops in a watershed can often lead to water quality and runoff problems. Elevated values for total nitrogen, nitrate + nitrite-N, total phosphorus, and turbidity gave some indication that agricultural practices could be impacting the water quality at the Little Tarkio Creek test stations. Nitrate + nitrite-N and total nitrogen were elevated at all of the test stations for both sampling seasons (Tables 9 and 10). Total phosphorous at test station #1 and turbidity at all of the test stations were elevated during the fall 2005 sampling season.

4.2 Stream Habitat Condition

The results of the stream habitat assessments indicated that Little Tarkio Creek was habitat impaired at all of the stations except station #4. (Tables 2 and 3). The conditions at test stations #2 and #3 were especially poor because of shallow water depths with little variation in depth and little or no good quality instream cover or bottom substrate. The general condition of Little Tarkio Creek downstream of station #4 was a straight narrow channel, sandy bottom substrate, shallow water depths, little woody debris, little rootmat, constant stream flow for most of the channel, and no riparian zone. Tall levees covered

with grass made up the riparian zone on both sides of the stream. The only exceptions to these conditions were at test station #1 where the stream channel was wider and woody debris was much more abundant. At test station #4 the stream was still narrow in width but had greater water depth, abundant woody debris and rootmat, was not leveed on both sides of the stream, and had some trees in the riparian zone. The lack of good habitat at test stations #1 through #3 indicates a potential source of stress for the biotic community.

4.3 Sinuosity

The low sinuosity values, except at test station #1, along with the presence of the tall levees on both sides of the stream are evidence that Little Tarkio Creek has been channelized. Station #1 was located in the middle of a river bend, causing a higher sinuosity value at this station. Other evidence that Little Tarkio Creek was channelized are topographic maps and personal observations that show that it is no longer in its original channel. Possible impacts of channelization, like headcutting, bank erosion, and unstable bottom substrates, could possibly have impacted and altered the macroinvertebrate community in Little Tarkio Creek.

4.4 Channel Measurements

Little Tarkio Creek channel width measurements, except test station #1, were much smaller than the channel widths at the biological criteria reference streams. The ratio of channel width to wetted width had a mean value of 1.26 at the Little Tarkio Creek test stations, which was much lower than the values at the biological criteria reference stations, except at Honey Creek. These two measurements showed that the Little Tarkio Creek test stations, except for test station #1, had a narrow channel in which water covered the majority of that channel. The results of channel width measurements are different from many channelized streams in northern Missouri which have a smaller wetted channel flowing through a much wider high bank channel (MDNR 2005d).

Little Tarkio Creek had shallow water depth measurements and low standard deviation of the water depths, except test station #4. Station #4 had water depths that were much deeper and had a higher standard deviation than the other Little Tarkio Creek test stations and the biological criteria reference stations. The ratio of wetted width to water depth was much higher at test station #1 than the biological criteria reference stations because of the wide channel and shallow water depths at this station. Stations #3 and #4 had much lower values for the ratio of wetted width to water depth since these stations had narrow channels and deeper water depths. The results of the water depth measurements, except test station #1, are different from many channelized streams in northern Missouri, which have wider wetted widths and shallower water depths (MDNR 2005d). The results from the channel measurements indicate that the channelization of Little Tarkio Creek has created a river system that is much different than other streams in northern Missouri.

4.5 Macroinvertebrate Community Condition and Composition

The macroinvertebrate samples collected at the Little Tarkio Creek test stations showed no impairment since the MSCI scores were fully sustainable for both the fall 2005 and spring 2006 sampling seasons (Table 6). This result was somewhat surprising since all of

the stations except station #4 were located in a section of stream that had been channelized into a ditch and had very poor stream habitat assessment scores. Habitat was especially poor at stations #2 and #3 where the stream had a narrow channel, shallow water depths, black coarse sand for a bottom substrate, little rootmat habitat, little snag habitat, and little non-flow depositional habitat. It had very little non-flow habitat because the stations were made up of shallow long runs that had a constant flow throughout the entire channel. The MSCI scores were higher for most stations during the fall 2005 sampling season than the spring 2006 sampling season. During the fall 2005 sampling season all of the stations except station #3 scored a perfect MSCI score of 20, but only station #3 had an MSCI score of 20 during the spring 2006 sampling season.

The percent of the samples made of EPTT was much higher during the fall 2005 sampling season than the spring 2006 sampling season. EPTT made up 32.3 to 59.1 percent of the samples during the fall 2005 sampling season, but only made up 2.3 to 18.9 percent of the samples during the spring 2006 sampling season (Tables 7 and 8). The netspinning caddisfly taxa *Hydropsyche* of the family Hydropsychidae was the most abundant EPT taxa collected during the fall 2005 sampling season. Hydropsychid caddisflies of the taxa *Hydropsyche*and *Cheumatopsyche* were extremely abundant at station #3 during the fall 2006 season, making up 42.6 percent of the sample. Hydropsychid caddisflies are probably well adapted to a stream system that has a constant flow like Little Tarkio Creek since they are filter feeders that construct nets that are used to collect food particles floating by in the water column. Chironomid and mayfly taxa like *Thienemannimyia* group, *Tanytarsus, Tricorythodes,* and *Stenacron* were also common in all or some of the samples collected during the fall 2005 sampling season. Chironomids were much more abundant and percent EPTT was much lower during the spring 2006 sampling season than the fall 2005 sampling season. Chironomids made up 68.7 to 93.9 percent of samples that were collected during the spring 2006 sampling season. Chironomids that were present in the samples were taxa that are commonly found in streams like *Cricotopus/Orthocladius* group, *Tanytarsus*, *Parakiefferiella*, *Thienemannimyia* group, and *Cricotopus bicinctus*. EPTT were not very abundant except for the netspinning caddisfly *Hydropsyche* at stations #2 and #3 during the spring 2006 sampling season. The higher abundance of chironomids and lower abundance of EPTT most likely contributed to the lower MSCI scores during the spring 2006 sampling season.

There is some evidence that macroinvertebrates may not be sensitive to habitat alterations caused by channelization like shallow water depths, but are sensitive to bottom substrate quality (Zwieg and Rabeni 2001). Little Tarkio Creek, like many of the biological criteria reference streams, has a bottom substrate that is predominately sand. The Little Tarkio Creek test stations may have had MSCI scores that were in the fully sustainable category since the bottom substrate of the test stations were similar to the substrate at the biological criteria reference streams. The fish community could be a better indicator of habitat alteration caused by channelization. Previous studies have shown differences in the fish community between channelized and unchannelized streams (Congdon 1971; Vokoun and Rabeni 2003). Many fish species, especially top level predators, require

habitat like deeper water in pools, large pieces of woody debris, and rootmat. Streams like Little Tarkio Creek that have very little of this type of habitat would most likely have a fish community that showed impairment.

5.0 Conclusions

Four null hypotheses were stated in the introduction section of this report: 1) the macroinvertebrate community will not differ between longitudinally separate reaches of Little Tarkio Creek; 2) the macroinvertebrate community in Little Tarkio Creek will not differ from data collected from biological criteria reference streams in the Plains/Missouri Tributaries between Nishnabotna and Platte Drainages EDU; 3) stream habitat assessment scores and channel measurements collected will not differ substantially between longitudinally separate reaches of Little Tarkio Creek; and 4) stream habitat assessments scores and channel measurements collected in Little Tarkio Creek will not differ substantially from data collected from biological criteria reference streams in the Plains/Missouri Tributaries between Nishnabotna and Platte Drainages EDU.

The first two null hypotheses related to the macroinvertebrate community were accepted. All of the Little Tarkio Creek test stations for both sampling seasons had MSCI scores that were in the fully sustainable category.

The last two null hypotheses related to stream habitat conditions were rejected. Stream habitat scores at the Little Tarkio Creek test stations #1 through #3 were below 75 percent of the habitat score at Honey Creek, a biological criteria reference station. There were also differences in the channel measurements collected at the Little Tarkio Creek test stations and the biological criteria reference streams. Channel widths at the Little Tarkio Creek test stations, except station #1, were smaller than the biological criteria reference streams. Another major difference was that water depth was much deeper and had a higher variation of water depth at test station #4 than the other Little Tarkio Creek test stations and the biological criteria reference streams. Visual observations, topographic maps, and sinuosity values were evidence that Little Tarkio Creek had been channelized. Little Tarkio Creek was no longer in its original channel and was transformed into a straight, narrow ditch that had tall grass-covered levees on both sides of the stream. There was little instream cover or habitat at test stations #2 and #3, most likely caused by the lack of trees in the riparian zone and the altered stream hydrology that was caused by the channelization.

6.0 Recommendations

1. Conduct a fish community bioassessment study of Little Tarkio Creek. Determine if habitat alterations to Little Tarkio Creek have affected the fish community, especially top predators.

2. Encourage best management practices to reduce the amounts of runoff in the watershed. Physicochemical data showed elevated levels for nutrients and turbidity in some samples.

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Appendix A

Statistical Analyses Comparing Watershed Size, Sinuosity, and Stream Channel Metrics Between the Little Tarkio Creek Test Stations and the Biological Criteria Reference Stations in Plains/Missouri Tributaries between Nishnabotna and Platte Drainages EDU

t-test Monday, December 04, 2006, 11:11:52

Data source: T-test comparing sinuosity between the Little Tarkio Creek test stations (except test station #1) and the biological criteria reference stations in the Plains/Missouri Tributaries between Nishnabotna and Platte Drainages EDU.

Normality Test: Passed (P = 0.141)

Equal Variance Test: Passed (P = 0.177)

Group Name	N	Missing	Mean	Std Dev	SEM
Reference	3	0	1.277	0.222	0.128
Test	3	0	1.020	0.0200	0.0115

Difference 0.257

t = 1.995 with 4 degrees of freedom. (P = 0.117)

95 percent confidence interval for difference of means: -0.100 to 0.614

The difference in the mean values of the two groups is not great enough to reject the possibility that the difference is due to random sampling variability. There is not a statistically significant difference between the input groups (P = 0.117).

Power of performed test with alpha = 0.050: 0.261

The power of the performed test (0.261) is below the desired power of 0.800.
You should interpret the negative findings cautiously.

t-test Monday, December 04, 2006, 11:05:40

Data source: T-test comparing watershed size between the Little Tarkio Creek test stations and the biological criteria reference stations in the Plains/Missouri Tributaries between Nishnabotna and Platte Drainages EDU.

Normality Test: Passed (P > 0.200)

Equal Variance Test: Passed (P = 0.212)

Group Name	N	Missing	Mean	Std Dev	SEM
Reference	3	0	48.333	33.471	19.325
Test	4	0	152.250	17.289	8.645

Difference -103.917

t = -5.432 with 5 degrees of freedom. (P = 0.003)

95 percent confidence interval for difference of means: -153.097 to -54.736

The difference in the mean values of the two groups is greater than would be expected by chance; there is a statistically significant difference between the input groups (P = 0.003).

Power of performed test with alpha = 0.050: 0.989

One Way Analysis of Variance Monday, December 11, 2006, 08:48:42

Data source: One-Way ANOVA comparing log-10 transformed channel width values between the Little Tarkio Creek test stations and the biological criteria reference stations in the Plains/Missouri Tributaries between Nishnabotna and Platte Drainages EDU.

Normality Test: Passed (P = 0.041)

Equal Variance Test: Passed (P = 0.505)

Group Name	N	Missing	Mean	Std Dev	SEM
Honey Creek #1	10	0	1.546	0.0446	0.0141
LB Platte R. #1	10	0	1.485	0.0820	0.0259
Wh. Cld Ck. #1	10	0	1.737	0.0917	0.0290
L Tarkio Ck. #1	10	0	1.574	0.0603	0.0191
L Tarkio Ck. #2	10	0	1.358	0.0427	0.0135
L Tarkio Ck. #3	10	0	1.220	0.0494	0.0156
L Tarkio Ck. #4	10	0	1.318	0.0714	0.0226

Source of Variation	DF	SS	MS	F	P
Between Groups	6	1.855	0.309	71.847	<0.001
Residual	63	0.271	0.00430		
Total	69	2.126			

The differences in the mean values among the treatment groups are greater than would be expected by chance; there is a statistically significant difference (P = <0.001).

Power of performed test with alpha = 0.050: 1.000

All Pairwise Multiple Comparison Procedures (Student-Newman-Keuls Method):

Comparisons for factor: **Sample Station**

Comparison	Diff of Means	p	q	P	P<0.050
Wh. Cld Ck. #1 vs. L Tarkio Ck. #3	0.516	7	24.892	<0.001	Yes
Wh. Cld Ck. #1 vs. L Tarkio Ck. #4	0.418	6	20.171	<0.001	Yes
Wh. Cld Ck. #1 vs. L Tarkio Ck. #2	0.379	5	18.255	<0.001	Yes
Wh. Cld Ck. #1 vs. LB Platte R. #1	0.252	4	12.143	<0.001	Yes
Wh. Cld Ck. #1 vs. Honey Creek #1	0.190	3	9.177	<0.001	Yes
Wh. Cld Ck. #1 vs. L Tarkio Ck. #1	0.163	2	7.844	<0.001	Yes
L Tarkio Ck. #1 vs. L Tarkio Ck. #3	0.354	6	17.048	<0.001	Yes
L Tarkio Ck. #1 vs. L Tarkio Ck. #4	0.256	5	12.327	<0.001	Yes
L Tarkio Ck. #1 vs. L Tarkio Ck. #2	0.216	4	10.411	<0.001	Yes
L Tarkio Ck. #1 vs. LB Platte R. #1	0.0892	3	4.298	0.010	Yes
L Tarkio Ck. #1 vs. Honey Creek #1	0.0277	2	1.333	0.350	No
Honey Creek #1 vs. L Tarkio Ck. #3	0.326	5	15.715	<0.001	Yes

Honey Creek #1 vs. L Tarkio Ck. #4	0.228	4	10.994	<0.001	Yes
Honey Creek #1 vs. L Tarkio Ck. #2	0.188	3	9.078	<0.001	Yes
Honey Creek #1 vs. LB Platte R. #1	0.0615	2	2.965	0.040	Yes
LB Platte R. #1 vs. L Tarkio Ck. #3	0.265	4	12.750	<0.001	Yes
LB Platte R. #1 vs. L Tarkio Ck. #4	0.167	3	8.028	<0.001	Yes
LB Platte R. #1 vs. L Tarkio Ck. #2	0.127	2	6.113	<0.001	Yes
L Tarkio Ck. #2 vs. L Tarkio Ck. #3	0.138	3	6.637	<0.001	Yes
L Tarkio Ck. #2 vs. L Tarkio Ck. #4	0.0397	2	1.916	0.181	No
L Tarkio Ck. #4 vs. L Tarkio Ck. #3	0.0979	2	4.721	0.002	Yes

One Way Analysis of Variance Monday, December 04, 2006, 10:33:29

Data source: Kruskall-Wallis ANOVA on ranks comparing wetted width values between the Little Tarkio Creek test stations and the biological criteria reference stations in the Plains/Missouri Tributaries between Nishnabotna and Platte Drainages EDU.

Normality Test: Failed (P = <0.001)

Test execution ended by user request, ANOVA on Ranks begun

Kruskal-Wallis One Way Analysis of Variance on Ranks Monday, December 04, 2006, 10:33:29

Data source: Data 1 in Notebook

Group	N	Missing	Median	25%	75%
Honey Creek #1	10	0	33.000	30.000	34.500
LB Platte R. #1	10	0	16.000	9.000	16.500
Wh. Cld Ck. #1	10	0	27.000	20.000	32.000
L Tarkio Ck. #1	10	0	28.750	26.000	33.000
L Tarkio Ck. #2	10	0	19.250	18.000	21.000
L Tarkio Ck. #3	10	0	12.250	11.500	15.000
L Tarkio Ck. #4	10	0	18.250	14.000	19.000

H = 42.353 with 6 degrees of freedom. (P = <0.001)

The differences in the median values among the treatment groups are greater than would be expected by chance; there is a statistically significant difference (P = <0.001).

To isolate the group or groups that differ from the others use a multiple comparison procedure.

All Pairwise Multiple Comparison Procedures (Student-Newman-Keuls Method):

Comparison	Diff of Ranks	q	P<0.05
Honey Creek #1 vs L Tarkio Ck. #3	428.000	6.651	Yes
Honey Creek #1 vs LB Platte R. #1	392.500	7.107	Yes
Honey Creek #1 vs L Tarkio Ck. #4	311.000	6.747	Yes
Honey Creek #1 vs L Tarkio Ck. #2	216.500	5.856	Yes
Honey Creek #1 vs Wh. Cld Ck. #1	125.000	4.490	Yes
Honey Creek #1 vs L Tarkio Ck. #1	28.500	1.523	No
L Tarkio Ck. #1 vs L Tarkio Ck. #3	399.500	7.234	Yes
L Tarkio Ck. #1 vs LB Platte R. #1	364.000	7.896	Yes
L Tarkio Ck. #1 vs L Tarkio Ck. #4	282.500	7.642	Yes
L Tarkio Ck. #1 vs L Tarkio Ck. #2	188.000	6.753	Yes

L Tarkio Ck. #1 vs Wh. Cld Ck. #1	96.500	5.158	Yes
Wh. Cld Ck. #1 vs L Tarkio Ck. #3	303.000	6.573	Yes
Wh. Cld Ck. #1 vs LB Platte R. #1	267.500	7.236	Yes
Wh. Cld Ck. #1 vs L Tarkio Ck. #4	186.000	6.681	Yes
Wh. Cld Ck. #1 vs L Tarkio Ck. #2	91.500	4.891	Yes
L Tarkio Ck. #2 vs L Tarkio Ck. #3	211.500	5.721	Yes
L Tarkio Ck. #2 vs LB Platte R. #1	176.000	6.322	Yes
L Tarkio Ck. #2 vs L Tarkio Ck. #4	94.500	5.051	Yes
L Tarkio Ck. #4 vs L Tarkio Ck. #3	117.000	4.203	Yes
L Tarkio Ck. #4 vs LB Platte R. #1	81.500	4.356	Yes
LB Platte R. #1 vs L Tarkio Ck. #3	35.500	1.898	No

Note: The multiple comparisons on ranks do not include an adjustment for ties.

One Way Analysis of Variance Monday, December 04, 2006, 10:25:34

Data source: Kruskall-Wallis ANOVA on ranks comparing the channel width to wetted width ratio values between the Little Tarkio Creek test stations and the biological criteria reference stations in the Plains/Missouri Tributaries between Nishnabotna and Platte Drainages EDU.

Normality Test: Failed (P = <0.001)

Test execution ended by user request, ANOVA on Ranks begun

Kruskal-Wallis One Way Analysis of Variance on Ranks Monday, December 04, 2006, 10:25:34

Data source: Data 1 in Notebook

Group	N	Missing	Median	25%	75%
Honey Creek #1	10	0	1.000	1.000	1.061
LB Platte R. #1	10	0	2.211	1.875	2.909
Wh. Cld Ck. #1	10	0	2.047	1.429	2.800
L Tarkio Ck. #1	10	0	1.297	1.167	1.458
L Tarkio Ck. #2	10	0	1.185	1.167	1.200
L Tarkio Ck. #3	10	0	1.317	1.152	1.360
L Tarkio Ck. #4	10	0	1.202	1.154	1.267

H = 28.051 with 6 degrees of freedom. (P = <0.001)

The differences in the median values among the treatment groups are greater than would be expected by chance; there is a statistically significant difference (P = <0.001).

To isolate the group or groups that differ from the others use a multiple comparison procedure.

All Pairwise Multiple Comparison Procedures (Student-Newman-Keuls Method):

Comparison	Diff of Ranks	q	P<0.05
LB Platte R. #1 vs Honey Creek #1	409.500	6.363	Yes
LB Platte R. #1 vs L Tarkio Ck. #2	290.000	5.251	Yes
LB Platte R. #1 vs L Tarkio Ck. #4	240.500	5.217	Yes
LB Platte R. #1 vs L Tarkio Ck. #3	192.500	5.207	Yes
LB Platte R. #1 vs L Tarkio Ck. #1	173.500	6.232	Yes
LB Platte R. #1 vs Wh. Cld Ck. #1	52.000	2.780	Yes
Wh. Cld Ck. #1 vs Honey Creek #1	357.500	6.473	Yes
Wh. Cld Ck. #1 vs L Tarkio Ck. #2	238.000	5.163	Yes
Wh. Cld Ck. #1 vs L Tarkio Ck. #4	188.500	5.099	Yes

Wh. Cld Ck. #1 vs L Tarkio Ck. #3	140.500	5.047	Yes
Wh. Cld Ck. #1 vs L Tarkio Ck. #1	121.500	6.494	Yes
L Tarkio Ck. #1 vs Honey Creek #1	236.000	5.120	Yes
L Tarkio Ck. #1 vs L Tarkio Ck. #2	116.500	3.151	No
L Tarkio Ck. #1 vs L Tarkio Ck. #4	67.000	2.407	Do Not Test
L Tarkio Ck. #1 vs L Tarkio Ck. #3	19.000	1.016	Do Not Test
L Tarkio Ck. #3 vs Honey Creek #1	217.000	5.870	Yes
L Tarkio Ck. #3 vs L Tarkio Ck. #2	97.500	3.502	Do Not Test
L Tarkio Ck. #3 vs L Tarkio Ck. #4	48.000	2.566	Do Not Test
L Tarkio Ck. #4 vs Honey Creek #1	169.000	6.071	Yes
L Tarkio Ck. #4 vs L Tarkio Ck. #2	49.500	2.646	Do Not Test
L Tarkio Ck. #2 vs Honey Creek #1	119.500	6.388	Yes

Note: The multiple comparisons on ranks do not include an adjustment for ties.

One Way Analysis of Variance Monday, December 04, 2006, 11:30:58

Data source: Kruskall-Wallis ANOVA on ranks comparing water depth between the Little Tarkio Creek test stations and the biological criteria reference stations in the Plains/Missouri Tributaries between Nishnabotna and Platte Drainages EDU.
Normality Test: Failed (P = <0.001)

Test execution ended by user request, ANOVA on Ranks begun

Kruskal-Wallis One Way Analysis of Variance on Ranks Monday, December 04, 2006, 11:30:58

Data source: Data 3 in Notebook

Group	N	Missing	Median	25%	75%
Honey Creek #1	30	0	1.425	1.250	2.050
LB Platte R. #1	30	0	0.475	0.250	0.700
Wh. Cld Ck. #1	30	0	0.800	0.400	1.150
L Tarkio Ck. #1	30	0	0.700	0.550	0.830
L Tarkio Ck. #2	30	0	1.000	0.900	1.000
L Tarkio Ck. #3	30	0	1.300	1.100	1.450
L Tarkio Ck. #4	30	0	2.850	1.900	3.400

H = 121.903 with 6 degrees of freedom. (P = <0.001)

The differences in the median values among the treatment groups are greater than would be expected by chance; there is a statistically significant difference (P = <0.001).

To isolate the group or groups that differ from the others use a multiple comparison procedure.

All Pairwise Multiple Comparison Procedures (Student-Newman-Keuls Method):

Comparison	Diff of Ranks	q	P<0.05
L Tarkio Ck. #4 vs LB Platte R. #1	3969.500	11.927	Yes
L Tarkio Ck. #4 vs L Tarkio Ck. #1	3811.000	13.353	Yes
L Tarkio Ck. #4 vs Wh. Cld Ck. #1	3186.500	13.391	Yes
L Tarkio Ck. #4 vs L Tarkio Ck. #2	2784.500	14.615	Yes
L Tarkio Ck. #4 vs L Tarkio Ck. #3	1424.000	9.952	Yes
L Tarkio Ck. #4 vs Honey Creek #1	1145.000	11.970	Yes
Honey Creek #1 vs LB Platte R. #1	2824.500	9.897	Yes
Honey Creek #1 vs L Tarkio Ck. #1	2666.000	11.204	Yes
Honey Creek #1 vs Wh. Cld Ck. #1	2041.500	10.715	Yes
Honey Creek #1 vs L Tarkio Ck. #2	1639.500	11.458	Yes
Honey Creek #1 vs L Tarkio Ck. #3	279.000	2.917	Yes

L Tarkio Ck. #3 vs LB Platte R. #1	2545.500	10.697	Yes
L Tarkio Ck. #3 vs L Tarkio Ck. #1	2387.000	12.529	Yes
L Tarkio Ck. #3 vs Wh. Cld Ck. #1	1762.500	12.317	Yes
L Tarkio Ck. #3 vs L Tarkio Ck. #2	1360.500	14.223	Yes
L Tarkio Ck. #2 vs LB Platte R. #1	1185.000	6.220	Yes
L Tarkio Ck. #2 vs L Tarkio Ck. #1	1026.500	7.174	Yes
L Tarkio Ck. #2 vs Wh. Cld Ck. #1	402.000	4.203	Yes
Wh. Cld Ck. #1 vs LB Platte R. #1	783.000	5.472	Yes
Wh. Cld Ck. #1 vs L Tarkio Ck. #1	624.500	6.529	Yes
L Tarkio Ck. #1 vs LB Platte R. #1	158.500	1.657	No

Note: The multiple comparisons on ranks do not include an adjustment for ties.

t-test Monday, December 04, 2006, 11:01:34

Data source: T-test comparing the standard deviation of water depth between the Little Tarkio Creek test stations (except test station #4) and the biological criteria reference stations in the Plains/Missouri Tributaries between Nishnabotna and Platte Drainages EDU.

Normality Test: Passed (P > 0.200)

Equal Variance Test: Passed (P = 0.839)

Group Name	N	Missing	Mean	Std Dev	SEM
Reference	3	0	0.589	0.0778	0.0449
Test	3	0	0.219	0.0692	0.0400

Difference 0.370

t = 6.153 with 4 degrees of freedom. (P = 0.004)

95 percent confidence interval for difference of means: 0.203 to 0.537

The difference in the mean values of the two groups is greater than would be expected by chance; there is a statistically significant difference between the input groups (P = 0.004).

Power of performed test with alpha = 0.050: 0.993

One Way Analysis of Variance Monday, December 11, 2006, 08:52:52

Data source: Kruskall-Wallis ANOVA on ranks comparing the wetted width to water depth ratio between the Little Tarkio Creek test stations and the biological criteria reference stations in the Plains/Missouri Tributaries between Nishnabotna and Platte Drainages EDU.

Normality Test: Failed (P = <0.001)

Test execution ended by user request, ANOVA on Ranks begun

Kruskal-Wallis One Way Analysis of Variance on Ranks Monday, December 11, 2006, 08:52:52

Data source: Data 1 in Notebook

Group	N	Missing	Median	25%	75%
Honey Creek #1	10	0	20.526	14.348	25.424
LB Platte R. #1	10	0	38.750	18.000	50.000
Wh. Cld Ck. #1	10	0	32.983	25.128	40.000
L Tarkio Ck. #1	10	0	43.837	37.143	54.545
L Tarkio Ck. #2	10	0	19.588	18.557	22.581
L Tarkio Ck. #3	10	0	9.211	8.759	13.043
L Tarkio Ck. #4	10	0	6.040	5.625	7.292

H = 46.894 with 6 degrees of freedom. (P = <0.001)

The differences in the median values among the treatment groups are greater than would be expected by chance; there is a statistically significant difference (P = <0.001).

To isolate the group or groups that differ from the others use a multiple comparison procedure.

All Pairwise Multiple Comparison Procedures (Student-Newman-Keuls Method):

Comparison	Diff of Ranks	q	P<0.05
L Tarkio Ck. #1 vs L Tarkio Ck. #4	513.000	7.971	Yes
L Tarkio Ck. #1 vs L Tarkio Ck. #3	422.000	7.641	Yes
L Tarkio Ck. #1 vs L Tarkio Ck. #2	225.000	4.881	Yes
L Tarkio Ck. #1 vs Honey Creek #1	224.000	6.059	Yes
L Tarkio Ck. #1 vs Wh. Cld Ck. #1	128.000	4.598	Yes
L Tarkio Ck. #1 vs LB Platte R. #1	112.000	5.987	Yes
LB Platte R. #1 vs L Tarkio Ck. #4	401.000	7.261	Yes
LB Platte R. #1 vs L Tarkio Ck. #3	310.000	6.725	Yes
LB Platte R. #1 vs L Tarkio Ck. #2	113.000	3.057	No

LB Platte R. #1 vs Honey Creek #1	112.000	4.023	Do Not Test
LB Platte R. #1 vs Wh. Cld Ck. #1	16.000	0.855	Do Not Test
Wh. Cld Ck. #1 vs L Tarkio Ck. #4	385.000	8.352	Yes
Wh. Cld Ck. #1 vs L Tarkio Ck. #3	294.000	7.953	Yes
Wh. Cld Ck. #1 vs L Tarkio Ck. #2	97.000	3.484	Do Not Test
Wh. Cld Ck. #1 vs Honey Creek #1	96.000	5.131	Do Not Test
Honey Creek #1 vs L Tarkio Ck. #4	289.000	7.817	Yes
Honey Creek #1 vs L Tarkio Ck. #3	198.000	7.112	Yes
Honey Creek #1 vs L Tarkio Ck. #2	1.000	0.0535	Do Not Test
L Tarkio Ck. #2 vs L Tarkio Ck. #4	288.000	10.345	Yes
L Tarkio Ck. #2 vs L Tarkio Ck. #3	197.000	10.530	Yes
L Tarkio Ck. #3 vs L Tarkio Ck. #4	91.000	4.864	Yes

Note: The multiple comparisons on ranks do not include an adjustment for ties.

t-test Monday, December 04, 2006, 11:19:44

Data source: T-test comparing maximum water depth between the Little Tarkio Creek test stations (except test station #4) and the biological criteria reference stations in the Plains/Missouri Tributaries between Nishnabotna and Platte Drainages EDU.

Normality Test: Passed (P = 0.095)

Equal Variance Test: Passed (P = 0.838)

Group Name	N	Missing	Mean	Std Dev	SEM
Reference	3	0	2.433	0.539	0.311
Test	3	0	1.417	0.425	0.246

Difference 1.017

t = 2.564 with 4 degrees of freedom. (P = 0.062)

95 percent confidence interval for difference of means: -0.0842 to 2.118

The difference in the mean values of the two groups is not great enough to reject the possibility that the difference is due to random sampling variability. There is not a statistically significant difference between the input groups (P = 0.062).

Power of performed test with alpha = 0.050: 0.434

The power of the performed test (0.434) is below the desired power of 0.800.
You should interpret the negative findings cautiously.

Appendix B

Little Tarkio Creek Bioassessment Study Macroinvertebrate Bench Sheets

Aquid Invertebrate Database Bench Sheet Report
Little Tarkio Ck [0503101], Station #1, Sample Date: 10/4/2005 2:30:00 PM
NF = Nonflow; RM = Rootmat; SG = Woody Debris; -99 = Presence

ORDER: TAXA	NF	RM	SG
AMPHIPODA			
Hyalella azteca			1
COLEOPTERA			
Dubiraphia	3	1	1
Gyrinus		1	
Helichus lithophilus			1
Hydrochus		2	
Hydroporus	1		
Laccophilus		2	
Macronychus glabratus			7
Ochthebius		34	
Paracymus		1	
Scirtidae		3	
Stenelmis			1
Uvarus		1	
DIPTERA			
Ablabesmyia	3	1	
Ceratopogoninae	14		
Chironomus	49	4	
Cricotopus bicinctus	7	21	7
Cricotopus/Orthocladius	10	11	16
Cryptochironomus	10	1	
Cryptotendipes	4	1	
Dicrotendipes	4	4	15
Glyptotendipes		3	
Hemerodromia		2	1
Labrundinia		1	
Limonia			1
Nanocladius		1	
Paracladopelma	1		
Parakiefferiella	1		
Paralauterborniella	2		
Polypedilum			4
Polypedilum convictum grp		6	
Polypedilum halterale grp	1		
Polypedilum illinoense grp	2	21	8
Procladius	1		
Rheotanytarsus		1	1
Stelechomyia			1
Stempellina	1		
Stenochironomus			11

Aquid Invertebrate Database Bench Sheet Report
Little Tarkio Ck [0503101], Station #1, Sample Date: 10/4/2005 2:30:00 PM
NF = Nonflow; RM = Rootmat; SG = Woody Debris; -99 = Presence

ORDER: TAXA	NF	RM	SG
Tanytarsus	10	14	23
Thienemanniella	1		1
Thienemannimyia grp.		31	26
Tipula		1	
Zavrelimyia		3	
EPHEMEROPTERA			
Baetis		3	19
Caenis latipennis	1	1	
Fallceon	1	16	19
Heptagenia		8	3
Heptageniidae	2		3
Isonychia rufa		1	1
Paracloeodes	1	2	3
Stenacron	1	1	5
Stenonema terminatum		2	13
Tricorythodes	3	9	17
HEMIPTERA			
Belostoma		1	-99
Mesovelia		1	
Ranatra fusca		1	
Rhagovelia	1	3	
Trichocorixa	110	20	32
LIMNOPHILA			
Lymnaeidae	1	1	2
Physella	1	9	2
ODONATA			
Argia		1	4
Hetaerina		5	
TRICHOPTERA			
Cheumatopsyche			3
Hydropsyche		35	107
Nectopsyche	1	30	4
Oecetis		1	
TUBIFICIDA			
Branchiura sowerbyi	2		
Limnodrilus hoffmeisteri	2		
Tubificidae	34	3	1
VENEROIDEA			
Sphaeriidae	-99	1	1

Aquid Invertebrate Database Bench Sheet Report
Little Tarkio Ck [0503102], Station #2, Sample Date: 10/4/2005 11:00:00 AM
NF = Nonflow; RM = Rootmat; SG = Woody Debris; -99 = Presence

ORDER: TAXA	NF	RM	SG
AMPHIPODA			
Hyalella azteca		4	
ARHYNCHOBDELLIDA			
Erpobdellidae		-99	
COLEOPTERA			
Berosus		1	
Dubiraphia	7	1	
Laccophilus		1	
Macronychus glabratus	3	7	14
Ochthebius	4	3	
Scirtidae			1
Stenelmis	2		1
Thermonectus		-99	
DIPTERA			
Ceratopogoninae	4	3	
Chironomus	7		
Cricotopus bicinctus	6	16	5
Cricotopus/Orthocladius	8	16	3
Cryptochironomus	38		
Cryptotendipes	43	4	2
Dicrotendipes	4	4	9
Dolichopodidae			1
Ephydridae		1	
Glyptotendipes			1
Labrundinia	2	8	
Larsia		5	
Nanocladius		7	
Natarsia			1
Ormosia			3
Parachironomus			3
Parakiefferiella	16	9	
Paralauterborniella	9	1	
Polypedilum		1	
Polypedilum convictum grp	3		1
Polypedilum halterale grp	1		
Polypedilum illinoense grp		4	1
Polypedilum scalaenum grp	1		
Rheocricotopus			1
Rheotanytarsus	2	1	2
Simulium		1	

Aquid Invertebrate Database Bench Sheet Report
Little Tarkio Ck [0503102], Station #2, Sample Date: 10/4/2005 11:00:00 AM
NF = Nonflow; RM = Rootmat; SG = Woody Debris; -99 = Presence

ORDER: TAXA	NF	RM	SG
Stempellinella	2		
Stenochironomus	1	1	16
Tanytarsus	43	42	11
Thienemanniella	1		
Thienemannimyia grp.	7	59	33
Tipula		1	1
EPHEMEROPTERA			
Baetis		1	4
Caenis latipennis			1
Fallceon	2	11	8
Heptagenia	1	8	5
Hexagenia		1	
Isonychia rufa		1	
Leptophlebiidae	1		
Paracloeodes	30	2	
Pentagenia vittigera	1	-99	
Stenacron		1	
Stenonema terminatum	3	7	7
Tricorythodes		20	6
HEMIPTERA			
Belostoma	1	1	
Mesovelia		2	
Trichocorixa	10	3	
LIMNOPHILA			
Lymnaeidae	2	5	1
Physella	1	6	
ODONATA			
Argia		5	
Gomphus	6		
Hetaerina	1	6	
Stylurus		-99	
TRICHOPTERA			
Cheumatopsyche	5	4	2
Hydropsyche	22	25	74
Nectopsyche	11	39	2
TUBIFICIDA			
Branchiura sowerbyi	1		
Enchytraeidae		1	
Tubificidae	10	12	4
VENEROIDEA			
Sphaeriidae	-99	1	

Aquid Invertebrate Database Bench Sheet Report
Little Tarkio Ck [0503102], Station #2, Sample Date: 10/4/2005 11:00:00 AM
NF = Nonflow; RM = Rootmat; SG = Woody Debris; -99 = Presence

ORDER: TAXA	NF	RM	SG

Aquid Invertebrate Database Bench Sheet Report
Little Tarkio Ck [0503103], Station #3, Sample Date: 10/4/2005 8:00:00 AM
NF = Nonflow; RM = Rootmat; SG = Woody Debris; -99 = Presence

ORDER: TAXA	NF	RM	SG
"HYDRACARINA"			
Acarina	1		1
AMPHIPODA			
Hyalella azteca			1
COLEOPTERA			
Berosus	1		
Dubiraphia	14	1	1
Macronychus glabratus	4	4	23
Ochthebius	2	2	
Stenelmis	1		1
Tropisternus		1	
DECAPODA			
Palaemonetes kadiakensis		-99	
DIPTERA			
Ablabesmyia	1	1	
Ceratopogoninae	9		
Chironomus	2		
Cricotopus bicinctus	5	3	
Cricotopus/Orthocladius	2	5	
Cryptochironomus	23		
Cryptotendipes	15		
Dicrotendipes	3	1	
Hemerodromia		1	
Labrundinia	1		
Nanocladius	1		
Parakiefferiella	9	3	
Paralauterborniella	1		
Parametriocnemus		1	
Paraphaenocladius		1	
Polypedilum		1	
Polypedilum convictum grp	11	6	
Polypedilum halterale grp	2		
Polypedilum illinoense grp		2	
Polypedilum scalaenum grp	1		
Rheocricotopus	3		1
Rheotanytarsus		1	
Simulium	2	4	

Aquid Invertebrate Database Bench Sheet Report
Little Tarkio Ck [0503102], Station #2, Sample Date: 10/4/2005 11:00:00 AM
NF = Nonflow; RM = Rootmat; SG = Woody Debris; -99 = Presence

ORDER: TAXA	NF	RM	SG
Stenochironomus	2	1	5
Tanytarsus	18	5	1
Thienemannimyia grp.	46	64	6
EPHEMEROPTERA			
Baetis	7	16	2
Caenis latipennis	1	1	
Heptagenia	3	2	
Paracloeodes	4	1	
Stenacron	2	2	
Stenonema terminatum	2	4	7
Tricorythodes	35	23	3
HEMIPTERA			
Belostoma		1	
LIMNOPHILA			
Lymnaeidae		1	
Physella		1	
ODONATA			
Argia	1		
Gomphidae		2	
Hetaerina	3	14	
Stylurus	2		
TRICHOPTERA			
Cheumatopsyche	26	42	88
Hydropsyche	39	64	153
Nectopsyche	16	29	
TUBIFICIDA			
Branchiura sowerbyi	2		
Tubificidae	35	1	
VENEROIDEA			
Sphaeriidae	2	2	

Aquid Invertebrate Database Bench Sheet Report
Little Tarkio Ck [0503103], Station #3, Sample Date: 10/4/2005 8:00:00 AM
NF = Nonflow; RM = Rootmat; SG = Woody Debris; -99 = Presence

ORDER: TAXA	NF	RM	SG
"HYDRACARINA"			
Acarina	1		1
AMPHIPODA			
Hyalella azteca			1
COLEOPTERA			
Berosus	1		
Dubiraphia	14	1	1
Macronychus glabratus	4	4	23
Ochthebius	2	2	
Stenelmis	1		1
Tropisternus		1	
DECAPODA			
Palaemonetes kadiakensis		-99	
DIPTERA			
Ablabesmyia	1	1	
Ceratopogoninae	9		
Chironomus	2		
Cricotopus bicinctus	5	3	
Cricotopus/Orthocladius	2	5	
Cryptochironomus	23		
Cryptotendipes	15		
Dicrotendipes	3	1	
Hemerodromia		1	
Labrundinia	1		
Nanocladius	1		
Parakiefferiella	9	3	
Paralauterborniella	1		
Parametriocnemus		1	
Paraphaenocladius		1	
Polypedilum		1	
Polypedilum convictum grp	11	6	
Polypedilum halterale grp	2		
Polypedilum illinoense grp		2	
Polypedilum scalaenum grp	1		
Rheocricotopus	3		1
Rheotanytarsus		1	
Simulium	2	4	
Stenochironomus	2	1	5
Tanytarsus	18	5	1
Thienemannimyia grp.	46	64	6
EPHEMEROPTERA			

Aquid Invertebrate Database Bench Sheet Report
Little Tarkio Ck [0503103], Station #3, Sample Date: 10/4/2005 8:00:00 AM
NF = Nonflow; RM = Rootmat; SG = Woody Debris; -99 = Presence

ORDER: TAXA	NF	RM	SG
Baetis	7	16	2
Caenis latipennis	1	1	
Heptagenia	3	2	
Paracloeodes	4	1	
Stenacron	2	2	
Stenonema terminatum	2	4	7
Tricorythodes	35	23	3
HEMIPTERA			
Belostoma		1	
LIMNOPHILA			
Lymnaeidae		1	
Physella		1	
ODONATA			
Argia	1		
Gomphidae		2	
Hetaerina	3	14	
Stylurus	2		
TRICHOPTERA			
Cheumatopsyche	26	42	88
Hydropsyche	39	64	153
Nectopsyche	16	29	
TUBIFICIDA			
Branchiura sowerbyi	2		
Tubificidae	35	1	
VENEROIDEA			
Sphaeriidae	2	2	

Aquid Invertebrate Database Bench Sheet Report
Little Tarkio Ck [0503104], Station #4, Sample Date: 10/3/2005 12:30:00 PM
NF = Nonflow; RM = Rootmat; SG = Woody Debris; -99 = Presence

ORDER: TAXA	NF	RM	SG
"HYDRACARINA"			
Acarina			1
AMPHIPODA			
Hyalella azteca		18	
ARHYNCHOBDELLIDA			
Erpobdellidae		-99	
COLEOPTERA			
Coleoptera			1
Dubiraphia	13	23	1
Helichus lithophilus		1	
Laccophilus	2	1	
Macronychus glabratus	3	11	32
Neoporus		2	
Ochthebius	1		
Scirtidae		5	
Stenelmis		1	8
Tropisternus		-99	
Uvarus		1	
DECAPODA			
Palaemonetes kadiakensis		-99	
DIPTERA			
Ablabesmyia	5	6	
Ceratopogoninae	8		
Chironomus	31		
Coelotanypus	1		
Cricotopus bicinctus	1	2	
Cricotopus/Orthocladius			1
Cryptochironomus	10		1
Cryptotendipes	1		
Dicrotendipes		3	1
Ephydridae	2		
Erioptera	1		
Forcipomyiinae	1		1
Gonomyia	2		
Harnischia		1	
Hemerodromia	2		3
Labrundinia	7	12	
Nanocladius	1	16	1
Parachironomus			1
Parakiefferiella	2	1	1
Paralauterborniella	2		

Aquid Invertebrate Database Bench Sheet Report
Little Tarkio Ck [0503104], Station #4, Sample Date: 10/3/2005 12:30:00 PM
NF = Nonflow; RM = Rootmat; SG = Woody Debris; -99 = Presence

ORDER: TAXA	NF	RM	SG
Paratanytarsus		1	
Polypedilum		1	
Polypedilum convictum grp		1	
Polypedilum fallax grp			1
Polypedilum illinoense grp	2	4	1
Polypedilum scalaenum grp			2
Procladius	12		
Rheocricotopus		1	
Simulium	3	1	1
Stempellinella	1		
Stenochironomus	2	3	83
Tanytarsus	5	7	
Thienemannimyia grp.	14	102	19
Tipula		1	
EPHEMEROPTERA			
Baetis	7		11
Caenis latipennis	4	3	2
Fallceon	7	3	5
Heptagenia	5		12
Heptageniidae	3	3	10
Hexagenia limbata	3		
Isonychia rufa	3	1	11
Leptophlebiidae	1		
Paracloeodes	2		3
Stenacron	6	8	35
Stenonema terminatum	1		6
Tricorythodes	59	60	39
HEMIPTERA			
Belostoma		-99	
Neoplea		1	
Trichocorixa	17		
LIMNOPHILA			
Lymnaeidae	1		
Physella		-99	
ODONATA			
Argia	4	26	2
Gomphus	1	1	
Hetaerina	1	5	
TRICHOPTERA			
Cheumatopsyche	1		25
Hydropsyche	10	1	164

Aquid Invertebrate Database Bench Sheet Report
Little Tarkio Ck [0503104], Station #4, Sample Date: 10/3/2005 12:30:00 PM
NF = Nonflow; RM = Rootmat; SG = Woody Debris; -99 = Presence

ORDER: TAXA	NF	RM	SG
Nectopsyche	11	17	1
Oecetis			1
TUBIFICIDA			
Branchiura sowerbyi			1
Enchytraeidae		3	2
Tubificidae	7	1	8
VENEROIDEA			
Sphaeriidae		1	

Aquid Invertebrate Database Bench Sheet Report
Little Tarkio Ck [0602615], Station #1, Sample Date: 3/14/2006 9:00:00 AM
NF = Nonflow; RM = Rootmat; SG = Woody Debris; -99 = Presence

ORDER: TAXA	NF	RM	SG
AMPHIPODA			
Hyalella azteca		3	
COLEOPTERA			
Dubiraphia		2	
Enochrus		1	
DIPTERA			
Ablabesmyia		1	
Ceratopogoninae	7		
Cladotanytarsus	2		
Cricotopus bicinctus		13	
Cricotopus/Orthocladius	36	484	161
Cryptochironomus	19	2	1
Cryptotendipes	28		
Dicrotendipes	6	2	21
Glyptotendipes			1
Harnischia	1		
Hemerodromia			1
Hydrobaenus	5		
Nanocladius		1	
Nilothauma	11		
Parakiefferiella	14	14	20
Parametriocnemus	1	1	4
Paraphaenocladius		30	7
Paratanytarsus		1	
Polypedilum convictum grp	2	30	16
Polypedilum halterale grp	1		
Polypedilum scalaenum grp	4	3	1
Rheocricotopus		1	
Rheosmittia	1		
Rheotanytarsus		1	1
Simulium		9	19
Stenochironomus			3
Tanytarsus	323	48	29
Thienemanniella		3	
Thienemannimyia grp.	1	38	8
Tipula		-99	
Zavrelimyia		6	
EPHEMEROPTERA			
Heptagenia		4	1
Hexagenia	2		

Aquid Invertebrate Database Bench Sheet Report
Little Tarkio Ck [0602615], Station #1, Sample Date: 3/14/2006 9:00:00 AM
NF = Nonflow; RM = Rootmat; SG = Woody Debris; -99 = Presence

ORDER: TAXA	NF	RM	SG
Stenonema terminatum	1	1	1
HEMIPTERA			
Belostoma		-99	
Trichocorixa	1		
LIMNOPHILA			
Physella		-99	
ODONATA			
Hetaerina		-99	
TRICHOPTERA			
Cheumatopsyche	-99	-99	1
Hydropsyche		7	6
Nectopsyche		6	5
TUBIFICIDA			
Branchiura sowerbyi	-99		
Enchytraeidae	1		
Limnodrilus claparedianus	1		
Tubificidae	6	4	
VENEROIDEA			
Sphaeriidae	-99		

Aquid Invertebrate Database Bench Sheet Report
Little Tarkio Ck [0602616], Station #2, Sample Date: 3/14/2006 11:45:00 AM
NF = Nonflow; RM = Rootmat; SG = Woody Debris; -99 = Presence

ORDER: TAXA	NF	RM	SG
COLEOPTERA			
Agabus		-99	
Berosus			1
Laccophilus		-99	
Macronychus glabratus			9
Neoporus		-99	
Ochthebius		1	
Peltodytes	1		
Stenelmis			2
Tropisternus		-99	
DECAPODA			
Palaemonetes kadiakensis		-99	
DIPTERA			
Ablabesmyia		1	
Ceratopogoninae	6	2	1
Cladotanytarsus	2		
Cricotopus bicinctus	7	69	11
Cricotopus/Orthocladius	19	64	14
Cryptochironomus	22	1	6
Cryptotendipes	19	2	
Dicrotendipes	5	2	4
Glyptotendipes			1
Harnischia		1	
Nanocladius		1	
Parakiefferiella	33	4	4
Paralauterborniella	8	1	
Paraphaenocladius	6	10	2
Polypedilum convictum grp	6	22	
Polypedilum halterale grp	18		
Polypedilum illinoense grp		4	
Polypedilum scalaenum grp	6	2	
Simulium		6	3
Tanytarsus	56	20	2
Thienemanniella	2	3	
Thienemannimyia grp.	1	19	28
Tipula		-99	
Zavrelimyia	4	7	3
EPHEMEROPTERA			
Heptagenia	1	-99	
Heptageniidae			1

Aquid Invertebrate Database Bench Sheet Report
Little Tarkio Ck [0602616], Station #2, Sample Date: 3/14/2006 11:45:00 AM
NF = Nonflow; RM = Rootmat; SG = Woody Debris; -99 = Presence

ORDER: TAXA	NF	RM	SG
Stenonema terminatum		2	3
HEMIPTERA			
Trichocorixa		1	
LIMNOPHILA			
Fossaria		1	
Physella		-99	
ODONATA			
Gomphus		-99	
PLECOPTERA			
Neoperla			1
TRICHOPTERA			
Cheumatopsyche	-99	1	8
Hydropsyche		2	34
Nectopsyche	2	6	
TUBIFICIDA			
Enchytraeidae		3	
Tubificidae	1	3	2
VENEROIDEA			
Sphaeriidae	3	1	

Aquid Invertebrate Database Bench Sheet Report
Little Tarkio Ck [0602617], Station #3, Sample Date: 3/13/2006 2:30:00 PM
NF = Nonflow; RM = Rootmat; SG = Woody Debris; -99 = Presence

ORDER: TAXA	NF	RM	SG
COLEOPTERA			
Dineutus		-99	
Dubiraphia	3	2	
Macronychus glabratus		2	23
Ochthebius		1	
Peltodytes	2		
Stenelmis	1		1
DECAPODA			
Palaemonetes kadiakensis		-99	
DIPTERA			
Ceratopogoninae	9	4	1
Chironomus		1	
Corynoneura		1	
Cricotopus bicinctus	76	110	10
Cricotopus/Orthocladius	52	80	35
Cryptochironomus	12	4	2
Dicrotendipes			16
Epoicocladius		1	
Hemerodromia			1
Hydrobaenus	1		
Nanocladius		6	1
Parakiefferiella	60	12	10
Paralauterborniella	8	2	
Parametriocnemus			1
Paraphaenocladius	3	8	
Polypedilum convictum grp	13	8	11
Polypedilum halterale grp	6		
Polypedilum scalaenum grp	1		
Rheocricotopus	2	1	
Rheotanytarsus		2	
Simulium	9	17	4
Stenochironomus			5
Tanytarsus	6	1	
Thienemanniella	10	9	2
Thienemannimyia grp.	32	27	35
Tipula		-99	
EPHEMEROPTERA			
Caenis latipennis		1	
Heptagenia	1		
Hexagenia limbata	2		

Aquid Invertebrate Database Bench Sheet Report
Little Tarkio Ck [0602617], Station #3, Sample Date: 3/13/2006 2:30:00 PM
NF = Nonflow; RM = Rootmat; SG = Woody Debris; -99 = Presence

ORDER: TAXA	NF	RM	SG
Isonychia rufa	1		
Leptophlebia		-99	
Stenacron	3	1	1
Stenonema terminatum	4	1	5
HEMIPTERA			
Belostoma		-99	
Ranatra fusca		1	
Trichocorixa	2		
LIMNOPHILA			
Physella	1	-99	
ODONATA			
Argia		2	
Gomphus		1	
Hetaerina			3
TRICHOPTERA			
Cheumatopsyche	7	1	8
Hydropsyche	14	6	124
Nectopsyche		7	1
TUBIFICIDA			
Branchiura sowerbyi	2	1	
Enchytraeidae		1	
Limnodrilus hoffmeisteri	3		
Tubificidae	13	7	2
VENEROIDEA			
Sphaeriidae	2		1

Aquid Invertebrate Database Bench Sheet Report
Little Tarkio Ck [0602618], Station #4, Sample Date: 3/13/2006 12:00:00 PM
NF = Nonflow; RM = Rootmat; SG = Woody Debris; -99 = Presence

ORDER: TAXA	NF	RM	SG
AMPHIPODA			
Hyalella azteca		16	
COLEOPTERA			
Berosus	1		
Dineutus		1	
Dubiraphia	10	15	
Laccophilus		1	
Macronychus glabratus		9	20
Neoporus		4	1
Peltodytes	4	2	
Scirtidae		1	
Stenelmis			2
Uvarus		2	
DECAPODA			
Palaemonetes kadiakensis	-99		
DIPTERA			
Ablabesmyia	1		
Ceratopogoninae	7	8	
Chironomus	1		
Cricotopus bicinctus	9	20	2
Cricotopus/Orthocladius	14	60	56
Cryptochironomus	11		
Dicrotendipes		4	5
Gonomyia		1	
Harnischia	3		
Hemerodromia	2		3
Hydrobaenus	5	1	
Nanocladius		11	1
Parakiefferiella	111	70	82
Paralauterborniella	31	1	1
Parametriocnemus			1
Paraphaenocladius	1	10	
Phaenopsectra		1	
Polypedilum convictum grp		1	1
Polypedilum fallax grp			1
Polypedilum illinoense grp		1	
Procladius	1		
Rheocricotopus	1		9
Rheotanytarsus		1	3
Simulium	1		4

Aquid Invertebrate Database Bench Sheet Report
Little Tarkio Ck [0602618], Station #4, Sample Date: 3/13/2006 12:00:00 PM
NF = Nonflow; RM = Rootmat; SG = Woody Debris; -99 = Presence

ORDER: TAXA	NF	RM	SG
Stenochironomus	2		49
Tanytarsus	4	1	2
Thienemanniella	4	3	2
Thienemannimyia grp.	9	52	31
Zavrelimyia	1	1	
EPHEMEROPTERA			
Caenis latipennis		1	1
Heptagenia	1	1	
Stenacron	5	1	5
Stenonema terminatum	1	1	3
HEMIPTERA			
Belostoma		-99	
Trichocorixa	49		
ODONATA			
Argia	1	13	
Boyeria		1	
Calopteryx		1	
Gomphus	1		
Hetaerina		2	
TRICHOPTERA			
Cheumatopsyche			2
Hydropsyche			24
Nectopsyche	3	17	8
TUBIFICIDA			
Branchiura sowerbyi	1		
Limnodrilus cervix	5		
Limnodrilus hoffmeisteri	4		
Tubificidae	15	1	